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EDITORIAL

THE STARS AND THE NIGHTSHADES

"Everything which hath being under Heaven receives it from the stars, and keeps it by their help." (Herbarius de Teutsche, 1485.)

IN THE Stone Age came the astrologer—the forerunner of the astronomer. Long prior to the Christian era, philosophy had come to associate all nature, men, animals, plants and mineral, either with a particular planet or with their constellations.

The primitive medicine man was a star gazer, and from his day onward almost to now, astrological medicine fills the annals.

Astrological medicine was governed by the doctrine that with the disease, the patient, the prognosis, the remedy, due regard must be had to the influence of the stars. One way of curing the ailment was by the use of herbs belonging to the planet which caused the disease. This was a cure by sympathy. Another way of treating illness was by the use of herbs belonging to the opposing planet, *e. g.*, diseases produced by Jupiter were healed by herbs of Mercury.

Hippocrates advised his son Thessalus to the study of "geometry and numbers (astronomy) because the rising and setting of the stars have a great effect on distempers."

In the middle of the eighteenth century, Sir Richard Mead wrote what was deemed a "master essay" entitled "A treatise concerning the influence of the sun and moon upon the human bodies and the diseases thereby produced." In this work he undertakes through "geometrical" calculation and formula to prove that the planets "cause various alterations in the human body, according to their different positions with respect to the earth."

In 1872 Dr. M. L. Knapp, of Nuevo Leon, Mexico, in a dissertation upon astronomical etiology, stated: "We see abundant reason in

the action of the sun on the earth (to say nothing of any other star) for the recognition of astronomical etiology."

Flammarion, the brilliant twentieth century astronomer, pointed out that the reciprocal influence of the stars of the universe near and remote affected each of these bodies, including the earth, its elements and organized existence thereon.

M. Daniel Berthelot, in a session of the Academie des Science in Paris (1926) declared that the stars and meteors exercise a direct influence upon the body and the nervous system of creatures living on our planet, particularly man.

The influence of the planets upon plant life runs through all time. Medical botany is filled with astrology.

Culpeper, who was a profound believer in astrology, gives us in his "British Herbal and Family Physician" a list of some five hundred plants, and the names of the planets which govern them.

The classification of plants under the planets was made according to the outward appearances of the plants themselves. The stalks, stems, branches, roots, foliage, flowers, odor, taste, native places and medical virtues were also considered; and, according to the character of the plant thus deduced, it was placed under the government of the particular planet with which it was considered to be most in consonance.

In astrological medical botany the narcotic solanums attain an exalted place. In the main, these particular plants were placed under the dominion of Saturn and Mars, with due regard to the moon.

The specific influence of the moon upon the narcotic group of solanums is emphasized by the herbalists, the magicians, the wise men and the philosophers. These plants must be gathered by moonlight or before sunrise. With the first appearance of the sun's rays all enchantment disappears and the spirits are driven to their subterranean abode. According to the great Roger Bacon, plants of this kind were governed by the moon's wax and wane. When the moon was propitious—that is during her growth—she instilled in these plants medicinal virtues. In the moon's wane—venom is distilled.

The three monographists on Belladonna (Faber, Sickles and Daries) show the influence of astrological botany and medicine. With Faber "Belladonna is a child of Saturn, a companion of Mars." The growth, the peculiar powers of the plant, for good and for evil, and its action upon man, are controlled through the conjunction of the

stars. Its particular form, and shape of leaf, root, flowers and stem, are the "signatures" through which its actions are to be read.

In describing a serious poison calamity following the eating of belladonna berries, Faber attributed the severity of the poison, the serious symptoms, and fatal results, to the fact that it happened on the thirtieth day of the month, when the moon had reached her full decline.

The elaborate frontispiece in Faber's "Strychnomania" is intended to represent the source of power found in belladonna as derived from the stars and is a witness of the orthodox belief in his time, as to the peculiar effects of belladonna upon mankind.

The influence of light from the planets and the stars upon the narcotic solanums and upon other drugs, pulsates through ancient medical lore, reaching down to our time.

We are in accord with the ancients in our studies as to the action of the sun and the light rays upon things living and upon things inanimate. We are curing disease, vitalizing and changing the body tissues, by the aid of natural, artificial, and "canned" rays of light.

Extended research is being made as to the action of light upon chemical substances and medicinal preparations. Drug substances irradiated by the rays of light are activated, modified, changed. Vitamins, those curious substances about which we talk so much and know so little, in some way seem to be bound up with and governed by rays of light.

Primitive man saw in the rainbow the moonglow of the mandragora—the source of its supernatural, diabolic power.

Modern searchers are seeking to tie up the purple color of the mydriatic solanums, the fluorescence in these and in other plants with their alkaloidal content.

For centuries the Italian physicians credited the cure of malaria by quinine to the fluorescence observed in the substance which it obtained during the growth of cinchona under tropical sunlight.

Now we have "discovered" that the fluorescence in quinine, coupled with the activating fluorescence of the blood—in short, the rays of light—is the thing that is deadly to the microbe of malaria. We are slowly coming to a realization of the properties of light in conjunction with such substances as fluorescent dyes.

Over the whole world herb gatherers follow the signs of the zodiac in gathering their crops.

Modern literature on the solanums attributes the variation in kind and quantity of their alkaloids to the weather conditions under which the plants have grown.

We are far away from the fantastic dreams of the astrologers. Science is ever changing its attitude. Such change is an evidence of its open mind. The pendulum may swing backward or it may swing forward. From age to age through this variation, science moves ever onward.

We may yet be able to "activate" the power of the narcotic nightshades and of other drugs by the rays of the sun, moon and stars. Who knows?

FREDERICK B. KILMER.

SELECTED EDITORIAL

DR. CLARA MARSHALL, Pioneer

(From the *Philadelphia Evening Bulletin.*)

AS ONE OF the pioneer women physicians in this part of the country, Dr. Clara Marshall, who was for almost the span of a generation the Dean of the Woman's Medical College in this city, did much to open the way for the entrance of women into a field of professional endeavor in which many of them have achieved distinction. When Dr. Marshall, the daughter of an old West Chester household, first attended the classes at the college, there was still considerable opposition to the woman physician, fostered and sustained by many of the older doctors who thought the art of healing was the prerogative of the men. But, like some of the other young women who had decided to take up the study of medicine, most of them in those days members of old Quaker families, Miss Marshall set out to make a thorough job of it.

After graduating from the Woman's Medical College in 1875—the institution was then twenty-five years old, although still small in size—Dr. Marshall enrolled as the first woman student in pharmacy in America, matriculating at the Philadelphia College of Pharmacy, and while studying there was called upon to arrange and direct the pharmaceutical exhibit at the Centennial Exhibition.

Meanwhile she had become Demonstrator of Pharmacy at the Woman's Medical College and won signal honor, when, still a recent graduate, she was appointed, in 1876, the Professor of Materia Medica and Therapeutics, a post which she continued to hold for thirty years. While she was thus engaged she became, in 1888, the dean of the college, holding that important office until 1917 when she resigned to become an emeritus professor.

Always fighting for woman's rights in the medical profession, Dr. Marshall was one of the principals in the great fight which was made in the '90s for the full recognition of the woman doctor by the County Medical Society. Many of the members of the society clung to the old traditions and when Dr. Marshall and Dr. George E. deSchweinitz were tied in the voting for the office of second vice-president there was a deal of excitement among some of the medicos until the matter was settled by the election of Dr. J. C. DaCosta.

Although other institutions like the Philadelphia Hospital, with whose staff she was connected in 1882, and the Nurses Training School at the Jefferson Hospital, claimed her attention, it was chiefly her alma mater which enlisted her interest and it was largely through her efforts that its hospital building on North College Avenue was erected. A voluminous writer on medical and other subjects, Dr. Marshall, who, in her more active years, was noted for her energy and enthusiasm, was also the author of a history of the college that she served until a few years ago.

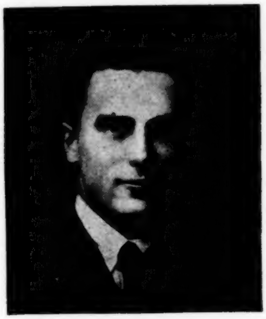
ORIGINAL ARTICLES

TREES

By Marin S. Dunn, Ph. D.

A. Forests and Forestry

THERE WAS a time, not so long ago, when the land comprising the state we know as Pennsylvania was far more heavily wooded than it is today. A vast forest, rich in kinds and numbers of its trees and abounding in wild life, covered much of the land. Because of its favorable location and climate, Pennsylvania was the common meeting place of tree species from the north, the south and the Mississippi basin. Giants, heavy with age, whose lofty heads had defied storm and cold for hundreds of years, were common. But, upon the arrival of the white man, conditions began to change. With wood so plentiful, little heed was taken to protect the forests, and grove after grove fell before the axe in order to clear land for homes and farms. Fires, due to intent or carelessness, played their parts in ruthlessly wiping out vast acres of valuable timber, leaving desolation and death in their wake. Lumbermen, destroying the wooden treasure chest by unregulated cutting, have completed the picture. With the passing of time, the inroads of fire and man have reduced the original dense forest to relatively small, open woodlands. Forest giants are still to be found, but not in great numbers.



Marin S. Dunn, Ph. D.

It must not be thought, however, that Pennsylvania is the only state where the conditions described above have occurred. The same tendencies have been in operation wherever many valuable trees were found. Economic pressure and carelessness, owing to overabundance of supply, with no thought of the future, are largely responsible for the despoiling of forests. A recent article appeared in the *New York Herald Tribune,* under the name of Nelson Courtlandt Brown, Acting Dean of the New York State College of Forestry, which brings out the point that, although New York was at one time the great pulp and paper-producing state of the nation, there is said today to be

only ten companies which have a supply of pulp sufficient to last ten years and only one company that has a twenty-year supply, and that, as a consequence, many paper and pulp companies are moving their mills to Canada.

But there is a hopeful side to the picture. Certain people of high ideals and standards, looking at the problem of forest conservation with a critical eye, and realizing where wood wastefulness will lead us, are doing much toward developing a constructive program in the treatment of our woodlands. This program consists, among other things, in awakening our people through educational channels to the value of the forest; the training of spirited young men in established schools of recognized worth to care scientifically for the present forests; fighting fire, fungus and insect, etc.; in acquiring and setting aside new forest land to be protected in the proper way; and by judicious tree planting.

Generations ago, 1681, in Pennsylvania, wise old William Penn, realizing the value of the forest, ordered the people to set aside one acre of trees for every five acres cleared. Nearly two centuries elapsed before any constructive work in forestry was done. In 1886 the Pennsylvania Forestry Association was founded and in 1895 a Division of Forestry was created in the Department of Agriculture, which later, in 1901, became the Department of Forestry. In 1903 the State Forest Academy at Mont Alto was established in order to prepare scientifically trained and equipped foresters to serve the state. To quote from "Pennsylvania Trees," (3), page 20, "The school aims to give the students a thorough and practical training in the surveying and mapping of forest areas; the growing of trees and their proper management from planting, through thinning to final logging and sawing; the protection of forests from fire, insects, fungi and trespass; the building and improvement of forest roads, trails, fire-lines, telephone-lines and fire towers; the estimation of timber and the calculation of its growth, value and financial returns; the directing of labor; the keeping of records and accounts; and some knowledge of business and forest law."

The graduates of this academy go out to all parts of the state teaching the importance of forestry and they also act as executives for the more than fifty state forests. These Pennsylvania state forests comprise 1,133,051 acres acquired 1898-1927, and 453,500 acres acquired 1927-1931. More than 36,000,000 trees have been planted in the State Forest of Pennsylvania which now equal in area a strip

nine miles wide across the entire state. New York is also intensively planting trees and, in the article by Nelson C. Brown referred to, the statement is made that 25,000,000 little forest trees were set out in 1929. "But even at this rate it would require about 200 years to put to work all the idle and abandoned lands that are unfit for agriculture and unprofitable if devoted to anything but trees. This is sadly but indeed true for the great Empire State. It is also true in almost comparable manner in New England, the lake states of Michigan, Wisconsin and Minnesota, throughout the southern states, and even in many parts of the rich agricultural states of the middle west."

Forests vary in different localities depending upon the environmental factors involved. In some woodlands, a single species of tree makes up 90 per cent. or over of the entire growth. This is called a pure stand. Pure stands in Pennsylvania are rare and, when found, are often conifers (cone-bearing trees). The opposite of the pure stand is the mixed one where two or more species enter into the composition of the woods, no one species making up 90 per cent. of the total. To the forester, pure stands may be established more easily and cheaply, but they lack some of the outstanding advantages of mixed stands, such as the ability to meet changing market demands and the full utilization of the foods in the soil.

A tree, like every other living thing, may enjoy a normal span of life and, in a forest, we may find all stages from young seedlings still in their babyhood to aged monarchs that are nearly dead. (The oldest tree in the world is said to be the giant cypress near Oaxaca in Mexico. Although not as high as the big redwoods of California, nor the eucalyptus of Australia, it has a circumference well over 100 feet near its base and is probably 5000 years old.)

Age, however, does not alone take its toll of trees, but many other influences are at work to bring about destruction and death.

Branches may be broken and entire trees uprooted by wind. Frost is often responsible for injuring the soft parts, such as buds and shoots, and it even causes the splitting of branches and fruits. Snow and ice, by their weight, are guilty of breaking branches; hail, especially in spring, may injure flowers and young fruits. In fact, heat and cold, if sufficiently pronounced, will destroy life. Lightning is one of the causes for the starting of forest fires which burn over large areas of land.

Grazing sheep and cattle play their part by eating the available plant food found within their reach. Insects are a serious menace

to our forests and each species of tree has its particular enemies. Some insects (scale insects, plant lice, etc.) belong to the type that have sucking mouth parts by which they are able to pierce fruits, young buds and twigs, and suck out the plant juices. Others have jaws adapted for chewing and destroy the actual plant body. The borers belong to the latter group and, as their name indicates, they are found in tunnels of their own construction in various parts of plants. Bailey (1) says, "The two apple-tree borers, the round-headed and the flat-headed species, and the peach-tree borer doubtless cause the death of as many apple and peach trees in America as all other enemies combined." Boring insects cannot be reached by spraying and they must actually be dug out, often a very difficult undertaking.

Fungi, including the bacteria, is a group of plants, some of whose members are extremely harmful to trees. Fungi are colorless plants which reproduce by little cells known as spores. These spores are extremely small and light and are carried by various natural agencies, such as the wind. If the spores come in contact with breaks or wounds in the surface of living plants and if there be favorable conditions present, such as proper moisture and heat, the spore cells may sprout into threads which, in turn, derive nourishment from the host plant and grow into or along the surface of the host. In many cases a conspicuous fungal growth, which may take various forms, depending upon the species of fungus, above the surface of the tree is associated with a great interwoven mass of fungal threads which has penetrated the tissues within the tree. As the growth of the fungus continues, more and more of the tree is damaged and, as a result, the tree may be seriously injured or even killed. Toadstools, mildews, rusts, blights and rots are types of fungi which are commonly known to almost everyone.

Man, himself, however, is the greatest living destroyer of trees. From the time of the pioneer, who was forced to wage his life-or-death battle with the forest, to the period where trees were ruthlessly cut with no heed for the future, man has been the great enemy of the forest. The responsibility lays at his door for most of the disastrous forest fires—fires which burn every year in Pennsylvania alone thousands of acres of timber. Old trees and young are not spared, but are left as charred wrecks after the passage of the fire. Statistics show that 2456 forest fires occurred in Pennsylvania during 1928. These burned over 110,872 acres, creating a damage of $360,000. A care-

lessly thrown cigarette butt, the lighted stub of a match, or a smouldering campfire may leave as a monument to the ignorance or indifference of man, himself, the ruins of a hundred acres or more of good timber and much animal life.

Strange as it may seem to many, many forest fires occur in April and May, and these produce a great deal of damage, since they burn plants at the time of most rapid cell division. It is said that the trees of Pennsylvania make 90 per cent. of their height growth during about forty days in spring. The spring sun dries the leaves on the forest floor before the season's new leaves are produced on the trees above, with the result that there is sufficient fuel in a readily burnable condition to be set off at the slightest cause. Another period of maximum fires occurs in autumn when the dead leaves cover the surface, and when they are not yet covered by the winter's snow. Young trees and young parts of trees are most apt to suffer from fire since here the cambium or growing layer is not heavily protected. As trees grow older, their mark becomes thicker and heavier with the result that they are better able to withstand exposure to fire. However, they are not always exempt from death because of their size. It is also known that some trees, such as conifers, the beech, etc., because of their nature, are injured far more than others.

Three general types of forest fires are recognized: (1) ground fires which burn into and through combustible soil, (2) surface fires which harm anything burnable in their path along the surface of the ground, (3) crown fires, fortunately few in Pennsylvania, which attack the upper portions of trees. If the wind is too strong, a fire which is normally a surface fire may become a crown fire. Trees having pitchy material may become living torches and quickly carry fire from below into their crowns.

In conclusion, forest fires produce damage only, and it is the duty of everyone to protect the forest against any act of carelessness which might endanger property and life. While in the woods or near burnable timber, be certain that any fire which should be out is entirely out. Beware, also, of the lighted cigar or cigarette stub which may be thrown from automobiles while driving on roads passing through woodland areas. It is advisable for every machine to have its own ash tray so available that it is accessible to all occupants of the car.

From the foregoing paragraphs, we see that nature, in order to hold her own, always faces the problem of making up the losses

occasioned by the various agencies just discussed. Not only must she repair damages to old forests, but new forests must be gradually built. One of her principal methods is by innumerable seeds, each of which contains a tiny embryo plant of exactly the same type as the parents that produced it. Seeds, themselves, may be developed inside of containers known as fruits. Seeds ripen at different times of the year, depending upon their kind, and may be carried from the parent plant in a number of ways. Often the fruits containing the seed show striking structural adaptations to their method of dispersal. For example, wind-borne fruits of the willow and aspen are equipped with hair, while those of the American elm, ash and maple have winglike expansions. Streams may carry certain fruits and seeds for varying distances. This is particularly true of those which are naturally built for floating, such as the American hop hornbeam with its bladderlike container. Some seeds, contained within succulent fruits, are swallowed by birds as they eat the juicy part. Such swallowed seeds may pass through the bird's intestines unharmed and come to fall in regions at a distance from the place of eating. This may be the fate of the seeds of the hollies. Certain seeds cling to the outside of the bodies of the forest inhabitants to which they may come in contact and may be carried far away before they are brushed off. Finally, in the case of those species growing on cliff sides, gravity may play its part.

Whatever the method of scattering, if the living seed finds itself in a location having suitable conditions, its embryo may develop into a new plant, and hence it is that we find the forest floor dotted with seedling trees in various stages of development. Each one, providing disaster does not occur, will become in time an adult forest tree. However, do not imagine for a minute that all the seeds formed by a tree will grow into a new plant. As Rogers (5) so aptly puts it, "Thousands of tree seeds are sown where but tens may hope to germinate and grow. Some seeds (e. g., willow) must germinate at once or they lose their vitality and die. Most of these cannot start unless they fall in very moist soil. So each has its peculiar limitations, and these keep the number of seedlings down." The willow, however, is able to surmount its seed difficulty by the ease with which branches are separated from the parent plant and falling in the water beside which the willow is growing, float off until a place is reached where they come into contact with land and may take root.

Still another way that natural regeneration may take place is by means of shoots and suckers. Many readers of this paper probably have noticed, again and again while walking through our woodlands, that certain tree stumps are surrounded by a ring of young sprouts. These shoots, fed by the root system of the parent plant, are rapid-growing. Oak, chestnut and various other deciduous (dropping their leaves as winter approaches) trees have this habit while it is limited to the redwood and pitch pine among conifers. Suckers are the growths which spring up from the roots or lower part of the stems of certain trees even though the parent tree be still standing. Go to your window, and if you have Lombardy poplars in your yard, you may notice this condition. The word "coppice" is applied to both shoots from the trunk stump and suckers springing from the roots. And coppice represents a quick method nature uses to repopulate her forests with trees.

Natural regeneration takes time and often is very wasteful, and so man has attempted to assist nature by guiding her and improving upon her methods. First, in this artificial method of regeneration, seeds are collected from suitable trees and are properly stored in protected places or planted at once. If they are sown immediately, two courses present themselves; either sowing them in the forest in locations where they are expected to develop into mature trees, or that of placing them in especially established nurseries at first. In Pennsylvania, the nursing seed beds are generally about twenty-five feet long and four feet wide, and after germination, the young seedlings break through the ground into the light of day. If too many seedlings develop in a single bed, some of them, as time goes on, are transferred to another location. This transplanting is really a good thing because the seedling plants that survive it are healthier and stronger. When the time arrives (which varies with different species—ash, one year; white pine, two or three years, etc.), the seedlings are taken up and replanted in the forest where it is intended that they shall grow. Trees, located in this way, are usually placed four by four or five by five feet from each other, resulting in from 1700 to over 2700 trees necessary per acre.

Another method is to take seedlings, which are germinating in the forest, and transfer them directly to the location where they will be used, and in this way to shape the forest to its own interests.

From the view of the lumber merchant, trees grown in open stands will produce lateral branches near the ground and, consequently, since the lumber obtained from the trunks of such trees is full of knots (each knot representing the influence of a side branch), the result is an inferior grade of wood. On the other hand, when the trees are grown comparatively near each other, lateral branches will appear higher up and the timber will yield relatively fewer knots. The expert forester, in developing a timber forest, will aim particularly to increase the yield of wood and make it more valuable than if left to nature alone.

The experienced forester will fit his methods to the problem at hand. In some cases he may use artificial regeneration, while in others he may allow natural regeneration to play its part and then fill in the gaps or vacant spaces artificially. The artificial method has been used to cover open areas. In Pennsylvania Trees (3) the statement is made, "Many of the forests which were established artificially are now reaching maturity. Disadvantages of this method are becoming more evident and the foresters are gradually substituting the natural method for the artificial." Let it be understood, however, that one method differs from the other, mainly by how much man assists nature and tries to shape her efforts.

B. Transplanting Trees

We have spoken before of transplanting but only in connection with seedlings. It is now time to say a few words about transplanting larger trees. To begin, a safe rule to follow as nearly as possible is that of not letting the tree know it has been moved. In other words, attempt to keep conditions during and after transplanting as nearly as possible like those to which the tree is accustomed. This is best done in early spring before the warming sun has awakened it from its long winter sleep.

If the tree under consideration possesses fibrous roots, dig carefully about it in a circle about as wide as the tree's crown, leaving the sod in place. Gradually work under the tree until it is possible to get it separated together with much of its root system still wrapped in its earthen ball. If there is a long fleshy tap root, as in the case of the white oak, this may be cut off at a little distance below the surface some months before the actual transplanting in order to give a chance for a more superficial root system to develop. In general,

if the root system is dense and shallow, as in the case of elms and maples, the chances of successful transplanting are better.

The roots of some trees, black walnut, horse-chestnut, beech, etc., are in intimate relationship with certain soil fungi. These fungal threads form a mantle (mycorrhiza) over the surface of the roots and may even penetrate the root cells and thus may assist the roots in absorbing nutrient materials from the soil. The ground under certain trees for example, is completely penetrated by these threads and if you transplant a tree of this kind to your garden, be sure to take some of the original soil in order that the fungal threads which the tree needs may not be missing. If your garden soil does not contain these threads, your tree may die.

In the last few years commercial concerns have found it possible to transplant large trees, using specially built equipment. In fact, it is now possible, if you possess inclination and money enough to convey living forest giants to your very door. Recently one reads in a New York paper of a number of large trees so conveyed and replanted. The list, as given, includes: one elm, forty-eight inches in diameter and 100 feet high; four elms, forty-two inches in diameter, ninety to 100 feet high; twenty elms and white pines, twenty-six to forty-two inches in diameter; 300 elms, white pines, maples and concolor fir, twelve to twenty-four incres in diameter. No longer must one wait through the years for one's trees to grow, but one may in a few weeks transform a bare house and lot into a shady old estate.

Julia Ellen Rogers in "Trees" (5), gives the following directions in replanting the young tree which has been taken from its woodland home. Dig the hole larger than the tree requires. Place a layer of especially rich soil on the bottom. Do not allow exposed roots to dry and the root hairs to shrivel. After trimming broken roots, place the plant on this rich bed in such a way that its roots are not cramped by being pushed together, but are placed naturally. Do not bury the tree too deeply, but try in every way possible to duplicate the original condition. Place good dirt around and between the roots. Add water if the tree is not dormant and then after it has soaked away, finish filling the hole with soil so that the tree may stand firmly. It pays to prune the top and thus shape it. In doing so, you not only form a fine top, but you may prevent the loss of too much water from the leaves before the root system is fully established and able to absorb sufficient water for its needs. As soon as you note signs of the awakening, thorough watering is needed.

C. Pruning Trees

And now, since we have mentioned pruning, it is a good place to briefly discuss a few general principles involved in this act which may be defined as the cutting out of parts for the improvement of the parts that remain. In this process, dead, diseased or injured parts are removed. Generally speaking, plants are best pruned in early spring, although dead parts may be removed at any time. Ornamental trees grown for their flowers, if early blooming, may be pruned after the blooming of the flowers. It all depends upon the purpose of the owner and the kind of tree as to the way in which pruning is carried out. We should hold in mind the picture of trees with their roots firmly fixed in the ground absorbing water and mineral salts from the soil and passing them upwards through their trunk to their leaves. If the desire is to lessen top growth, the roots may be pruned. On the other hand, if the terminal buds are removed, increased activity on the part of those buds which remain leads to a thickly branched and spreading plant. This, in turn, leads to the production of flowers and fruits, rather than wood. Hence, if the tree is a fruit tree, pruning includes the removal of the growing regions at the top and, later, it may also embrace a thinning of the remaining branches so that the energy which goes into the formation of the fruit will not be expended in a great number of mediocre clusters but shall be concentrated in the very finest producible.

In the case of forest trees, where the purpose is to raise wood, the terminal buds are not removed but the plants are induced to grow clean and straight with as much wood as possible. In many cases the branches near the ground die and are removed by nature in her own way. If, however, this does not occur, it may be necessary to clear them.

In the case of evergreen trees, the terminal bud of the main trunk should never be cut, although it may be necessary, at times, in order to shape the tree, to remove the terminal buds of side branches in order that the remaining bud system develops more fully and thus produces a compact head of foliage.

Tender shoots may be pinched back by hand or by the use of a sharp pruning knife. If, however, the tree is older, and its limbs so thick that the use of special pruning implements is rendered difficult, it may be necessary to use a saw. Always cut the limb off at its base as nearly as possible on a level with the branch from which

it arises. Never leave a long stump or stub behind to decay. A hatchet or axe would cause an uneven torn surface or possibly a long split, through which infection may more easily occur. Where the stub is long, the dead wood becoming wet through rain, affords ideal conditions for the entrance and germination of fungal spores. The result is decay, which may eat through the stub into the vital parts of the tree. In the process of healing, new tissue is formed at the sides of the cut branch and closes in over the wound. The longer the stub, the more difficult this process.

After the cutting has been accomplished, it is necessary to sterilize and waterproof the wound. The purpose of this is to kill fungal spores lodged upon the wound and to prevent the entrance of water. To some extent it also guards against boring insects. Corrosive sublimate of proper strength is one of the best antiseptics for this purpose, while a paint composed of linseed oil and white lead, or liquid asphaltum, may be used for waterproofing.

D. The Tree

Let us pause at this point in order that we may get a better idea of the organization of a tree. Take some tree—almost any tree will do—and look at it more closely. (Fig. 2.)

It is composed of millions upon millions of tiny cells of various sizes and shapes. Cells of common origin, structure and function are grouped to form tissues and these tissues in turn make up the fundamental plant organs—root, stems, leaf, flower, fruit and seed. (Fig. 2.)

The roots are embedded in the soil and have for functions anchorage, storage and absorption of water and mineral salts found in the ground. This crude sap is passed upward through certain channels known as fibrovascular bundles or just bundles (Figs. 2, 7), into the stem or tree trunk and eventually reaches, by smaller and smaller side branches, the flat expanses called leaves. The leaves have the power, by virtue of their green substance—chlorophyll—of utilizing the vast energy of sunlight to build up complex food, such as starch, out of water which reaches them from the roots and from the carbon dioxide gas which enters them from the atmosphere. (Fig. 1.) Some of this elaborated food, thus made, is used as food for the cells that form it—the remainder, in the form of sugar, is passed out of the leaves through fibrovascular bundles to various

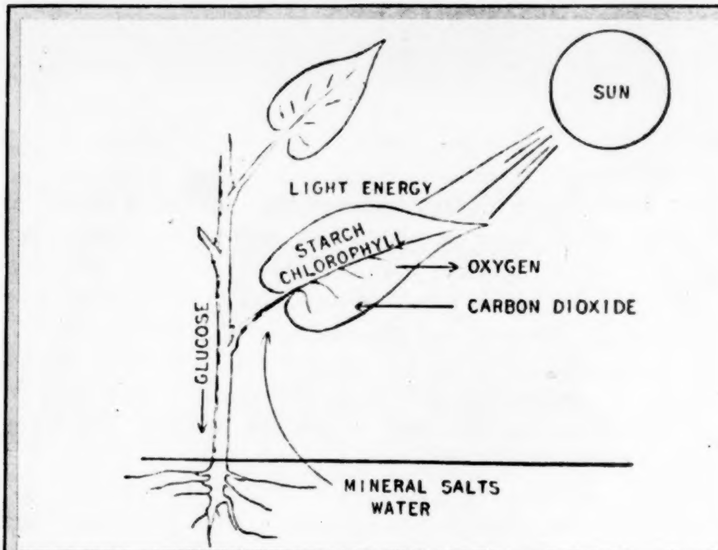


FIG. 1

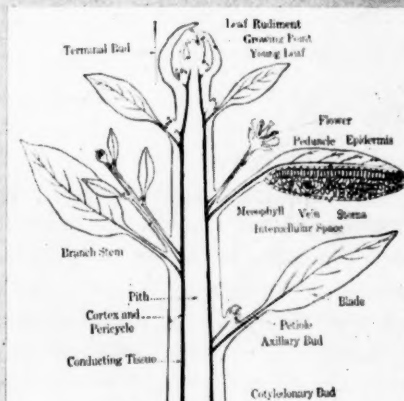


FIG. 2

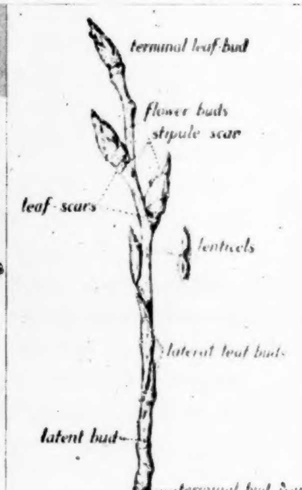


FIG. 3

Fig 1—Diagram of Starch-Making.
This is taken from Youngken, "Pharmaceutical Botany," P. Blakiston's Son & Co., who in turn took it (after Atwood).

Fig. 2—Diagram of the Body of a Seed Plant Such as a Tree Showing Its Principal Parts.
This is taken from Youngken, "Pharmaceutical Botany," P. Blakiston's Son & Co., who in turn took it (from Robbins, after Holman and Robbins).

Fig. 3—Cottonwood Twig, Two Years Old.
This was taken from Youngken, "Phamaceutical Botany," P. Blakiston's Son & Co., who in turn took it (from Robbins, after Longyear).

other parts of the tree, where it is either used or stored for future use. (See Fig. 1.)

Light is probably favorable, although not necessary, for protein formation. As a consequence, protein formation may occur in any living cell, but especially in foliage leaves.

The growing tip of the stem ends in a bud and other buds, or side branches which have developed from buds, are evident as we proceed backward from the tip. The side branches, in turn, possess buds and these may be more or less developed. The nearer we come to the apex of the shoot, the younger are the buds. (Figs. 2, 3.)

We may learn much by examining the well-preserved stump of a transversely cut tree. There are two prominent regions, of which the outer we recognize as bark and the ringed inner portion as the wood. (Figs. 6, 7.) The bark and the wood are separated by an inconspicuous layer of growing and dividing cells, known as the cambium. (Fig. 7.) If the stump we are examining is a short one, that is if the tree has originally been cut near its base, then by carefully counting the growth rings (Figs. 6, 7), we are able to form some estimate of the age of the tree, allowing one ring for one year. The wood, itself, is made up of long tubes, shorter cells and taper-pointed wood fibers. The long tubes called tracheæ were the principal agents in the conduction upward of crude sap when the tree was alive; while the fibers gave strength and elasticity. The outer region or bark is composed of distinct zones. The outer part of the bark is corky and constituted a waterproof covering of variable thickness, while the inner part next to the cambium was really a conductive region, some of whose cells or tubes carried the elaborated food made in the leaves to various other parts of the plant.

At certain times, flower clusters or inflorescences arise whose position and structure are characteristic of the species of tree. Each flower is composed of certain whorls of modified leaves (Fig. 2) called in order passing from without to within—sepals, petals, stamens or male parts, and carpels or female parts. Not all flowers have the complete number of whorls, however. For example, in some species, the stamens may be lacking and the flower is then called pistillate. In others the reverse is true and the flowers are staminate. The sassafras and the willow have staminate and pistillate flowers borne on different plants of the same species, while in the case of the maple, both staminate and pistillate flowers as well as flowers containing both stamens and carpels, are found on the same tree. Stamens

produce pollen grains, which in turn develop the male germ and, from the basal part or ovary of the carpel or carpels, is developed the fruit. Sometimes other regions near the ovary wall are connected to it and aid in fruit formation. Inside of the fruit are found one or more structures known as seeds. Each seed usually contains an embryo which is the result of an union between a female germ or egg and a male germ or sperm developed by a pollen grain. If proper conditions arrive, the embryo may grow and escape from the seed, developing in time into an adult plant like the one from which it sprang.

Let it be said in finishing the picture of the tree that every living part of every plant from the toughest fruit to the softest flower and from the highest bud to the deepest root is constantly breathing and,

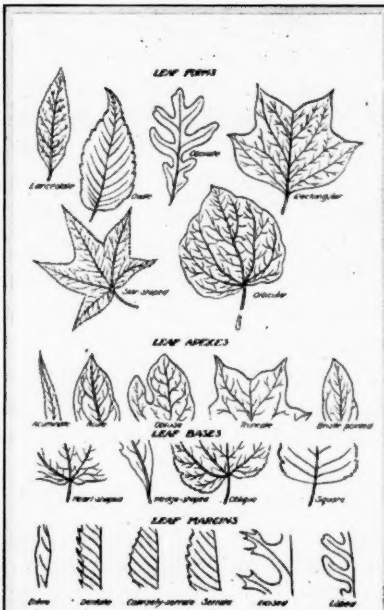


FIG. 4

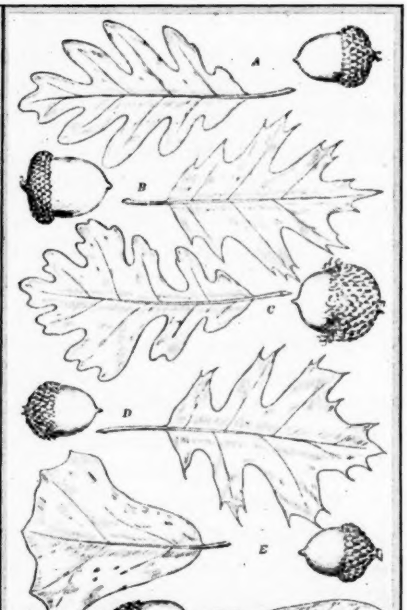


FIG. 5

Fig. 4—Types of Leaves.

Taken from "Pennsylvania Trees," by Joseph S. Illick. Bulletin issued by Director of the Commissioner of Forestry, Harrisburg, Pa.

Fig. 5—A Group of Leaves and Acorns Illustrating Some of the Differences Between Six Species of Oak; A, White Oak; B, Red Oak; C, Bur Oak; D, Black Oak; E, Blackjack Oak; F, Live Oak.

Taken from Haupt, "Fundamentals of Biology," McGraw-Hill Book Company, where it bears the legend (from Bergen & Caldwell, "Practical Botany," Ginn & Company, after Hough, by permission).

by so doing, is liberating energy which it uses in its life processes—without which life would be impossible. In short, each living tree has those peculiar properties which are common to every other living thing—plant or animal: structure, ability to use food and dispose of waste products, response to stimuli and reproduction.

E. Identification

"What tree is that?" is a commonly heard question which is too often answered by a shake of the head. True, many people recognize certain usually found trees, such as the buttonwoods and maples of our yards and streets, but even here confusion often results when the tree is devoid of one or two especially distinguishing features, such as leaves or fruits. And even, when known, a maple is often only a maple without certainty as to whether it is a silver, sugar, Norway, red or other species of maple. The study of trees in winter is just as fascinating and interesting as in other seasons, but it is often necessary to form judgments without the aid of the chief identifying characteristics before mentioned. In your study of trees, do not depend entirely upon the information given by a few parts, no matter how indicative, but obtain as much knowledge as possible before drawing conclusions concerning the following parts: general form, bark, twig, buds, leaves, leaf scars and bundle scars, wood, flowers and fruit.

a. *General Form:* People who are familiar with trees are able to recognize certain ones at a glance, even though some distance away. This they do by their characteristic form or appearance. It becomes a game to sit in a moving train or automobile and, looking at the passing vegetation, to say "that is an oak" or "there is an elm," and many hours of otherwise tiresome traveling may be frequently passed pleasantly and profitably. Of course, to do this with any degree of skill, it is necessary to have marked previously certain trees of known identity in your neighborhood and to have studied them from time to time, throughout the year. A tree devoid of leaves appears to be very different from a fully clothed one. Classified according to branching, trees fall into two groups: the first includes those which have one central trunk, like we observe in the pines, while to the second division belong those trees, such as the elm, in which the main trunk divides near its base into a number of more or less equal branches.

b. *Bark:* Bark, as has already been stated, may be divided into two zones (Figs. 6, 7): the inner is conductive, while the outer is protective. The outer region is protective, owing to its corky formation which guards against the excessive loss of water, and prevents the entrance of parasitic insects. Young bark, before the cork develops, is greenish, and in the case of sassafras, the green color is retained for a long time. As bark ages and thickens, it may become rougher and looks very different. The characteristic appearance of the buttonwood, a tree common on our city streets, is due to the dark-brown outer bark peeling off and allowing the greenish or yellowish bark inside to appear. In some species, like the beech, the bark remains smooth throughout life but in many other cases it roughens and cracks and peels off in a definite way as time goes on. Thus the bark of the beautiful paper birch peels off in layers like paper. Scales are formed in the pines and spruces, and shreds in the white cedar. Characteristic furrows and ridges appear in the bark of many trees, such as the black gum.

c. *Twigs:* Twigs usually are small branchlets representing the current season's growth and have taken their origin from vegetative buds which were located terminally or laterally on the twigs of last season's growth. If a twig develops from a terminal bud, it becomes a leader and usually develops faster than if laterally placed. Young

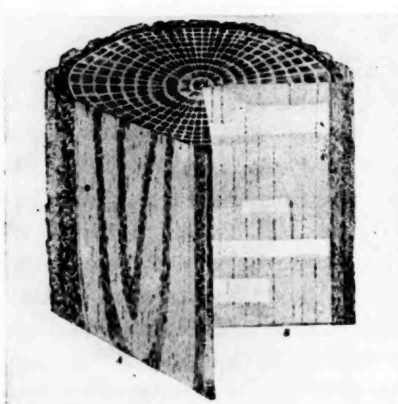


Fig. 6—Diagrammatic Drawing of an Oak Log, Showing Cross-Section or End View of Log, a View of a Surface (Tangential) at A Made by Sawing Off a Slab From the Side of the Log, and a View of a Surface (Radial) at B, Made by Sawing From Periphery to Center.

Reprinted by permission from "Botany with Agricultural Applications," by John N. Martin; published by John Wiley & Sons, Inc.

twigs are at first greenish, but gradually change color as they get older and the outer bark develops. Special little openings, known as lenticels, in varying number, may be present which allow the interchange of gases and thus help in the vital processes. Lenticels may be raised above the bark, as in the elder, or they may be level with it. We are all familiar with the short transverse lines found on the bark of cherry trees and birches. These are due to lenticels which are so united as to produce this result. In addition to lenticels, twigs may be hairy and possess scars where leaves or scales have been attached and have dropped. (Fig. 3.)

Something may also be learned by a study of the pith at the center of the twig. Although small, in some species, this may be large in proportion to the size of the twig as in sumach or in sassafras. Its outline in cross-section may be star-shaped, as in the oaks; three-angled in the alder, circular in the elm and ovoid in the linden. Its color, too, is important for it may be white as in the sugar maple; greenish as in the shad bush; red as in the Kentucky coffee tree, or brown as in the striped maple.

d. *Buds:* Buds are short young shoots or growing points with tiny leaves arranged upon them. (Fig. 3.) They are one of the ways in which the plant answers the threats of winter. Within the overlying scales or sticky substances of the bud, as the case may be, the embryonic growing point is protected from cold, and the following spring, when low temperatures have disappeared, opening takes place and growth and development starts. The amount of protection that a bud needs varies with the plant and its location. Buds which have no scaly covering are termed naked buds. Buds may be of three kinds, according to future development: a leaf bud, developing into a leafy branch; a flower bud, producing a branch with one or more flowers; or a mixed bud, forming a branch with flowers and leaves.

In position, buds may be terminal at the end of the stem; lateral or axillary, that is, arising in the crotch of a leaf along the side of the stem; accessory or extra, which form in or near the leaf axil as in young red maple; adventitious which are produced in unusual places. Lateral buds may be placed alternate to each other on the stem or they may be opposite or even whorled. Terminal buds may be solitary as in the beech, or in groups, as in the oak.

In size and form there is a great difference. Some are long, slender and sharp pointed, as in the beech; some are spherical, as the

terminal flower buds of the dogwood. Some buds may remain undeveloped for years, but given the cause, such as too much food or death of a number of terminal buds, and they may become active again. In other words, they constitute one of nature's "factors of safety."

e. *Leaves:* A typical leaf is composed of a flat, expanded green portion known as the blade or lamina, a stalk or petiole and leaf-like appendages called stipules. Leaves vary greatly in size and shape. Fig. 5 is given to show how the leaves may characteristically vary among different species of the same genus—oaks in this case—and by no means are all the different species of oak shown. It is impossible in the time and space allotted to this paper to do any more than to generalize in a brief way. Many trees are commonly recognized by the leaves which they possess.

Leaves may be either simple, as in the maple where they are composed of a single blade, or they may be compound, as we see in the locust, where each leaf is divided into smaller divisions, or leaflets. Leaves may be opposite each other, as in the maple, or they may be alternate, as in the chestnut.

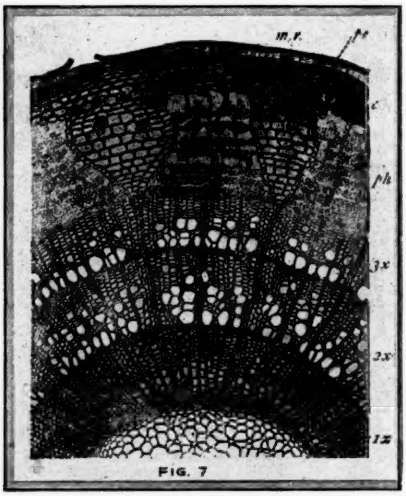


Fig. 7—Representative Portion of a Transverse Section of a Linden Stem, Three Years Old; 1x, 2x, 3x, Successive Annual Rings of Wood; ph, Inner Bark With Fibers Showing as Lighter Parts and Conduction Tubes as Darker Parts; c, Cortex With Crystals; m. r., Spreading End of a Primary Medullary Ray; pe, Cork.

Illustration from Youngken, "Pharmaceutical Botany," P. Blakiston's Son & Co. (from Small, after Kuy).

In the description of any leaf, attention should be given to the general outline, that is, the form viewed as a whole without regard to marginal indentations; the type of point or apex; the kind of base; the characteristics of the margin; the system of veining; and the texture of the leaf. Textbooks and reference books use a long list of terms which are applicable to the various types of the characteristics above mentioned. A list and explanation of these are out of place in this paper and the interested reader is referred to "Pennsylvania Trees," (3) page 44, or to any complete botanical text, such as "Pharmaceutical Botany," by Youngken (7). Fig. 4 used with the kind permission of Dr. Illick, shows a few types.

As winter approaches and as the leaves of deciduous trees are assuming their coats of yellow, brown and red, a zone of thin-walled cells is formed across the base of the leaf stalk with the result that, when the time arrives, even a slight breeze will break the hold of the leaf upon the tree and it will flutter earthward. An examination of the scar left where the leaf was attached will reveal a protective corky covering.

f. *Leaf Scars and Bundle Scars:* Trees which shed their leaves in winter are known as deciduous trees. Whenever a leaf is shed a scar is left behind where the leaf was formerly attached. This scar is known as the leaf scar (Fig. 3), and, since also the bundles or conducting elements which passed from the branch or twig into the leaf must also have been broken in the dropping off of the leaf, we must find the scars of these within the leaf scars. The last-mentioned scars are known as bundle scars.

Leaf scars are arranged just as the leaves which come before them and they are diagnostically helpful, especially in winter, because in different kinds of trees they vary in size, shape, position and in the number of bundle scars they contain. For example, the leaf scars of the sourwood are alternate, nearly triangular, with a single compound bundle scar, while in the case of the white ash they are opposite, semicircular, with numerous small bundle scars.

g. *Wood:* This region of trees is developed inside of the cambium ring (Fig. 6, 7). It must be remembered that the cambium is the zone of actively dividing cells. Those cells which are formed to the inside of the cambium each year become the elements of the wood. In spring, growth is active and large vessels are produced with but few wood fibers of small diameter. In summer and autumn the reverse is true and smaller vessels together with many wood fibers

appear. The result is the open wood of one spring is in contact with the dense growth of the previous summer and autumn. (See Fig. 7.) Thus it may be seen that each year produces its own growth ring, delimited from the year before and the year after, and that the annual ring is a record of one year of growth of the wood.

Stems and then the larger branches yield the best wood. The quality of wood from the roots is poor. "High-grade material is usually obtained from the stems of valuable species which have attained a large size, are free from lateral branches, and possess little stem taper" (3). The presence or absence and arrangement of, if present, the large conduction vessels in the wood may be used as a basis of identification. There are three types: (1) non-porous, such as in the pine; (2) equal pored, as in the beech in which the pores are about of equal size and are found uniformly throughout the year's growth; and (3) unequal pored, such as in the oak, chestnut and linden, where the large pores are found in the spring wood only. (Fig. 7.)

Extending from the central pith and crossing the rings of growth are lines of cells known as medullary rays. (Figs. 6, 7.) These also vary in width and heighth. In the study of a specimen of wood, three types of sections should be observed microscopically—a transverse (Fig. 7), a radial longitudinal taken parallel to the medullary rays and, hence, passing through the center of the pith and a tangential longitudinal which cuts the specimen at a tangent to the circumference and, hence, at right angles to the medullary rays. In each section the arrangement of the wood elements and their structure should be noted.

Annual rings and medullary rays are important to man in connection with the furniture industry. Quarter-sawed or radially-sawed lumber is wood that is cut so that the broad surface of the board is parallel with the medullary rays and it owes its beauty to them. (Fig. 6-B.) Plain-sawed or tangentially-sawed lumber owes its appeal to the markings formed by the annual rings (Fig. 6-A).

As the wood elements get older and find themselves farther and farther removed from the cambium, they cease to function and die. Thus there may be two more or less differentiated regions of wood in most of our trees—the living sapwood near the cambium and the dead and often colored heartwood.

h. *Flowers:* Individual flowers differ from each other in time of appearance, duration, shape, size, color and number and relation-

ship of their parts. In addition, the arrangement of flowers upon the flowering branch is important. Thus, flowers of the walnut are structurally different from those of the tulip tree and arranged in a different manner.

Some flowers, walnuts, birches, oaks, etc., especially of wind pollinated plants, are relatively inconspicuous but produce great amounts of dry, wind-borne pollen. Other trees of which the tulip tree and magnolia are representatives, produce large showy blooms. Pollen grains, also, make an interesting and valuable study since they vary in form in different species of trees and yet are on the whole uniform for any one species. For example, the pollen grains of the sassafras are spherical while those of the pine are characterized by having two winglike extensions of use in buoyancy. With respect to inflorescence or arrangement of flowers, we have many types varying from the solitary flower of the papaw to branches with many side-stalked flowers (the longer-stalked and older flowers being near the base of the branch), in the locust to almost stemless flowers arranged along a branch (spikes) in the hickory, to the flat-top inflorescences of the hawthorn and to the compact knoblike heads of the buttonwood tree. For a further discussion of the subject, the reader is recommended to any good textbook of botany, such as Youngken's "Pharmaceutical Botany" (7) and to "Pennsylvania Trees" by Illick (3).

i. *Fruits:* Many common trees are popularly recognized by their fruits—that is if the person identifying the tree is fortunate enough to discover that the fruits are still associated with the tree. In this way an acorn means an oak, a chestnut bur a chestnut, a certain kind of winged key a maple, and for that matter an apple, an apple tree. Usually the fruit develops from the ovary of a single flower (simple fruit) although sometimes, as in the case of the osage orange, it is the product of a flower cluster (multiple fruits).

Some simple fruits are dry and break open, as those of the magnolia; some are dry and split, as the dry winged key of the maple; and some are dry and do not break open or split, as in the case of the nuts of the oak, beech, alder and chestnut. Other simple fruits are succulent and fleshy, such as the cherry, apple and quince.

Inside of the fruit are one or more seeds. Each seed should be studied as to its method of attachment to the fruit, the type of seed coats it possesses, its markings and the kind of reserve food it contains. For, as we have said before, inside of each seed is a little living embryo plantlet surrounded or provided with sufficient reserve

food so that upon the establishment of suitable conditions, nutriment may not be lacking for growth to take place. Each embryo consists of a minute main axis with root and shoot and one or two small seed leaves which in some cases may store a great deal of reserve food and in others may be comparatively poor, with the food stored in the cells located between the seed coats and the embryo. When germination begins, the insoluble stored food is converted through the activities of enzymes into soluble food and this is used to nourish the little embryo which begins to elongate, pushing its way out of the seed coat covering. The root portion grows downward, and the shoot portion goes toward the light, and as a result, the little seedling becomes established and will, if given the opportunity, develop into another plant like the kind from which it came.

It is hoped that the technicalities of description of the last few pages have not wearied or confused the reader since these details have been presented only in order that an idea might be given concerning the tools of classification. It is not necessary for the beginner to puzzle himself with a long list of hard names. By making the study of trees a hobby, and by keeping constantly at it, by becoming familiar with a tree here and there, and by now and then adding a few understood terms to the vocabulary, progress will be enjoyable and satisfactory. It will be a great advantage to the student if he is able to equip himself with a good pocket magnifying lens and, also, if it is possible for him to obtain access to one of the compound microscopes at the nearest high school or college.

F. Conclusion

The forest is forever influencing our life. From it, we obtain among other things: dyes; wood for fuel, houses, books, newspapers, furniture, machinery and even clothing; the skins of animals; and fruits including nuts. Telegraph a hundred miles and your message passes over 6000 poles of wood, and there are 3000 wooden ties to every mile of railroad. It is estimated that the coal mining industries of Pennsylvania consume 108,350,000 cubic feet of wood per year and that 306,000 cords of wood are annually used in cooperage and veneering in Pennsylvania.

Among the branches of the forest trees live the birds which feed upon insects hostile to our crops. The forest floor is covered and protected from erosion by the decaying remains of plants and animals

called humus which absorbs and holds water from rains and melting snows, thus slowing the run-off to the forest streams and preventing floods. Thriving industries, large towns and a progressive and a prosperous people result from well-managed forests.

The forest is a place of beauty and, with wise handling, will be a great influence for strong, healthy bodies and clean minds of our citizens. "If you are a citizen of Pennsylvania, you are one of the 10,000,000 stockholders in the State forests. This gives you permission to use the State forests to enjoy yourself. All that is required of you is that you obey a few simple rules and this every patriotic citizen is willing to do. . . . The aim of the State Department of Forests and Waters is to handle them so that they will produce continuous crops of forest products and bring a full measure of other benefits to the citizens of the State" (4).

In closing, may I leave this message with you: Become familiar with our forests, enjoy wholesome recreation in them, and obtain the benefits they give. In turn, cherish them and help to protect them against their enemies—insect, fungi, fire and heedless man.

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VENTILATION AND COMFORT*

By Professor David Wilbur Horn

WHEN THE SUBJECT of a popular lecture is as familiar as this one, there is small need for apologies for the absence of experiments and demonstrations. All that we shall deal with will be easily imagined by you in forms built up largely by drawing from your own experience.

Ventilation is derived from a Latin word meaning *wind*. Moving or re-moving air is the essence of our systems of ventilation. Figuratively we speak of ventilating some subject by "exposing it to the winds of public criticism." As used today the word *ventilation* includes also the factors of temperature and humidity, for these have established themselves in our experience as more or less concerned in the comfort and discomfort determined by ventilation.

TO TEMPER

To *temper* is to reduce in violence of intensity, and in this way to render less uncomfortable. The idea in the minds of most of us is well expressed in the familiar line from Stern's "Sentimental Journey"; "God tempers the wind to the shorn lamb". More exactly, "the temperature of a body may be defined as that property of the body which determines the flow of heat".

HUMIDITY

Humid is derived directly from a word that means, to be moist ,and it with its derivatives are seldom if evei used in any other connection.

GAS

Man must have learned very early the imperative need for moving away from his vicinity the air he had been breathing, for we know of no written record of this important discovery. But his ideas upon this subject must have been very hazy. Until as late as the 16th century, air was air, an imponderable element. The conception of different airs, each a distinct material, came only as the consequence of exact experiment, and led to the coining of the word *gas* by Van Helmont (1577-1644). Today everybody knows that air is a mixture of many gases.

*One of a Series of Popular Science Lectures given at the Philadelphia College of Pharmacy and Science, 1930 Season.

In that age of rapidly developing knowledge of gases and of air, how natural to look in this new direction for some explanation of the difficulties with indoor air.

The fact that man had invented and developed windows shortly after he had roofed his houses may be an expression of his belief that there was something in rebreathed indoor air that ought to be let out, or that unbreathed outdoor air ought to be let in. There can be little doubt from the descriptions of the modes of living of the middle ages, that odors and man's sense of smell played an important rôle, and dictated to some extent his views on the matter of rebreathed air *versus* fresh air.

With this mediæval setting, it was logical to search for some gas in open air that was not to be found to the same extent in rebreathed air. Nor could it have caused much surprise when, after the first recognition of the gas later to be called oxygen, another investigator announced that expired air contained considerable amounts of a gas, found in the open air only in minute quantities,—later called carbon dioxide. As time passed, this substance so characteristic of expired air was shown to cause the death of animals placed in it, and it was shown that air deprived of oxygen also produced the same deadly effects. With man's experiences with rebreathed air, and with these scientific discoveries about air as premises, the syllogism was soon compieted: the ill effects of rebreathed air were due to the diminished oxygen or the increased carbon dioxide, or both. And the problem was laid aside as solved, not alone for that day but solved for all time.

This was clear reasoning and was better than no reasoning at all. But very clear reasoning may be very misleading. Logic is not truthful. There are experimental ways to demonstrate the truth.

With respect to vitiated air, the first line of invincible argument against the accepted theory was chemical and physiological. Experiment demonstrated that when the oxygen in air is reduced to the lowest limit found in closed, crowded rooms, the hæmoglobin of the arterial blood is still *saturated* with oxygen. As a result of the chemical affinity of hæmoglobin for oxygen, the blood cells may still take up practically their full capacity, even when the oxygen is reduced to 12 per cent. Pure air contains about 21 per cent. of oxygen, air from the closest halls, crowded with people, seldom falls below 20 per cent. in oxygen content. It is a fact that nature does not take full advantage herself of this wide limit of 8 per cent. to 9 per cent. of oxygen.

Instead she allows man a wide factor of safety, for alveolar air contains only about 16 per cent. of oxygen. In other words, as to oxygen, the air within the lungs is maintained normally at a percentage at least 4 per cent. lower than that of the most vitiated air of any ordinary place, and 4 per cent. higher than is absolutely necessary in order to supply the blood with all the oxygen it needs. Further, neither a deficiency nor a surplus of oxygen in the air, unless extreme, has any effect whatever upon the respiratory movements. Therefore, the reduced oxygen content of expired air cannot be the cause of its ill effects.

The increased carbon dioxide content of rebreathed air remains to be considered. The facts here are much as follows: At each breath we take back into the lungs expired air which has come to rest in the nose and larger bronchii—the so-called "dead-space air." This dead space air equals about one-third of a quiet inspiration. The air of the lungs is therefore very impure, and never even remotely approaches pure air in composition. Nature seems especially to have provided that pure air never should enter the air cells of the lungs. This provision is more than a physiological accident. It is useful and necessary. It makes of breathing a continuous process instead of an intermittent one, and so provides a constant supply of oxygen. The nerve center which controls respiration depends for its stimulation on carbon dioxide dissolved in the blood. If the carbon dioxide falls too low, stimulation stops until the proper concentration of carbon dioxide is reaccumulated in the blood; then stimulation takes place and respiration is restored. This concentration of carbon dioxide in the blood is reached when the amount of carbon dioxide in the alveolar air is about 5 per cent. By reason of the nice adjustment of the reflexes controlling the depth of breathing, the concentration of carbon dioxide in the lungs is thus kept at its normal uniform level regardless of whether we breathe much or little expired air. "The balance is maintained automatically and without our consciousness, and the limits of this automatic regulation of the volume of air inspired goes far beyond the limit of the necessity for change placed upon it by any respiratory contamination that is ever likely to be found in the air of even the most crowded rooms."

BAD AIR As the ground beneath these old chemical theories relating to vitiated air was softening and showing signs of giving way, the time-honored prejudice against odors was

brought out and used to shore up the crumbling structure. Odors have in many instances profound psychological effects, of which fear is one. The Chinese sought to win battles by carrying forward enormous censers producing foul odors. "Sewer gas" has been notoriously dangerous. The emanations from swamps have been credited with producing all the ills that have been preceded by the adjective "malarial"—from the Latin, *bad air*. The sure prophylaxis against malaria itself consisted in keeping the windows closed at night. From the point of view of general health some night hours acquired especially bad reputations. Thus Hamlet says:

> " 'Tis now the very witching time of night;
> When graveyards yawn, and *hell itself breathes out*
> *Contagion* to this world."

It is a fact of observation that odors usually are noticeable in a closed room when the carbon dioxide content of the air has risen to nearly twice its normal value, that is, to 0.006 per cent.

But science is practical, not sentimental.

The moisture in the vitiated air of rooms when condensed contains notable amounts of the organic impurities previously in the air of the room. This condensed moisture has been injected into normal experimental animals, and even into sensitized animals where the remarkable phenomena of anaphylaxis would enormously aggravate the effect of any protein poison if present—without poisonous effects. It has been thirty-five years since it was first clearly pointed out that if one is strictly cleanly in clothing and person, no odorous substances are given off. And we still self-righteously condemn the ventilation, when we find ourselves in a room of ill-smelling vitiated air.

"The proper study of mankind is Man." The direct study of men in enclosed air-spaces, such as air-tight rooms, has given the correct explanation of his discomfort in rebreathed air. Men have been enclosed in air-tight cabinets until the effects of rebreathed air have become unmistakably evident. Men *outside* the cabinet have then begun and continued to breath through tubes the air from within the cabinet—entirely without discomfort and without discoverable ill effects. Then, men within the cabinet have begun and continued to breathe through tubes, fresh air from the outside—entirely without discoverable amelioration of their discomfort and distress. Obviously the ill effects of bad air are not due to the air inside of the lungs, but

are due to the air that is outside of the body. Further experiments show an immediate restoration of the confined men to comfort and normality, by modifying the enclosed air of the cabinet in any one of the three following ways: (1) by cooling it, (2) by drying it, (3) by moving it. So that now, well on in the 20th century, we are coming to use intelligently, in room temperature and ventilation the means given us by discovery in mediæval times; I refer to the thermometer, the hygrometer and the anæmometer.

Let us now take a less anthropomorphic view of the animal, man, in his relations to heat and moisture and wind, in order to formulate his problem more clearly. To begin with, the Egyptian mummy is a very dry fellow because he has lost the 58.5 to 65.0 per cent. of water that was in life a part of him. Man is a moist, living mass of colloidal solutions, emulsions and jellies, supported on a small amount of mineral matter. He may be looked upon as similar to a living sponge that in the past withdrew from his native element, the sea, and has since lived immersed and at the bottom of an ocean of more or less moist and more or less quiet air. This moist, spongy organism is constantly losing water by evaporation and by flow; if irremediable drying out is to be prevented water must be constantly poured into it. Any agency that disturbs the balance that ages of habit have established with respect to gain and loss of water, is potentially destructive to this organism, and it therefore reacts to such disturbances. For example, it is stated, "In such a place as Death Valley in summer, with the thermometer at 100° to 135° in the shade, it is almost impossible to drink enough water to preserve normal physiological conditions. . . . People who stay through the summer are in danger of suffering permanent injury to health." The problem of water balance in this organism is accompanied inseparably by a similar problem of heat balance. This organism is constantly losing heat, and must constantly have heat put into it if irremediable damage is to be avoided. Any agency that disturbs the balance that ages of habit has established with respect to gain and loss of heat is potentially destructive to this organism, and it therefore reacts to such disturbances. From the highest air temperatures man experiences in some of the industries, to the lowest met in polar explorations, is about 325°, but if the changes are not too sudden and unexpected, man is usually able to contrive a way to survive. Studies of artificial hibernation produced at will in certain other warm-blooded animals have led to the conclusion that "all the arrangements in the animal economy for the

production and loss of heat are themselves fully regulated by the central nervous system, there being a thermogenic center—situated above the spinal cord, and according to some observers, in the optic thalamus." The source of his heat, as of the rest of his energy, is his food, and on a 3000 calorie diet man turns out, as heat alone, somewhere around enough energy to raise five and a half million pounds one foot vertically against gravity, or in the more usual heat units, about 7000 British thermal units (B.T.U.'s) in twenty-four hours. Assuming that his body will heat up in just the same ratio as water, unless a 150-pound man is relieved of this heat he will develop within an hour a fever reading about 100.4° F. and in about four hours his temperature would reach 106.° As a man sometimes succeeds in continuing his existence upward of 600,000 hours, that is, for "three score years and ten," he must have ready means of losing heat.

Man loses about 50 per cent. of the water and 3 per cent. of the heat in the urine and fæces; about 10 per cent. of the water and 20 per cent. of the heat by respiration through the lungs; and about 40 per cent. of the water and 77 per cent. of the heat through the skin. It is evident then that in heat loss the skin is a far more important organ than are the lungs and that in water loss it ranks in importance with the kidneys. It is therefore to be expected that the air outside the body is of more importance than the air inside the lungs, because the air outside the body is the receptacle for all of the water and most of the heat lost through the skin.

The main methods of heat loss through the skin are by convection, radiation and evaporation. The heat loss through the lungs is by evaporation. The heat loss by convection decreases as the temperature of the air increases, falling from an estimated 425 B.T.U. per hour at 56° F. (with 56 per cent. humidity) to zero B.T.U. per hour when the air is at blood heat (with 56 per cent. humidity). On the other hand, the heat loss by evaporation increases with increasing air temperature, rising from an estimated value of 50 B.T.U. per hour at 56° F. (with 56 per cent. humidity) to 400 B.T.U. per hour when the air is at blood heat (with 56 per cent. humidity). The heat losses by radiation are but slightly known, but are held to decrease with rise of air temperature.

At elevated air temperatures, therefore, it is absolutely necessary for man to be able to evaporate water rapidly from his body into the air. But the capacity of the air at any temperature, for water, depends upon how much water it can still take up at that temperature

before it becomes saturated with water. The less water there is already in the air at any temperature, the more water it can take up (at that temperature) and therefore the more heat it can relieve man of *via* evaporation from this body. The more water there is already in the air at any temperature, the less it can take up (at that temperature) and therefore the less is it suited to relieve man of heat by evaporation. If now the temperature of the air is high, since heat loss by convection and radiation has thereby been diminished, it is evident that if the warm air is also moist, the heat loss by evaporation is also diminished—and the discomfort that is the prodrome of heat-stroke appears. Reflex actions through the thermogenic center in the central nervous system now stimulate the flow of blood to the skin, thereby causing an elevation of temperature at its surface and thus facilitating the loss of heat by convection and radiation—to compensate for the reduced loss by evaporation. For example, in the case of weaving mill workers who operate amid the steam blown into the sheds, and whose bodies and clothing are consequently moist, the skin of the face has been found to be 4° to 13° F. higher in the mill (wet bulb 71° F.) than when at home (wet bulb 55° F.).

Where it is impossible to moderate the temperature or reduce the moisture in the air, a satisfactory remedy is the third one mentioned in the cabinet experiments—namely, to move the air. This does not mean to empty the closed space and fill it with fresh air; it means, to set the air within the closed space in motion. In the cabinet experiments, for example, the surface skin temperature of a man rose 4.3° F. in 13 minutes, due to elevated temperature and moisture-content in the air; but dropped 4.5° F. immediately after a fan, under which he was standing, was started. "At 80° F., with moderate humidity, or 70° to 75° F., with high humidity, almost all persons begin to show depression, headache, dizziness and a tendency to nausea. . . . The subjective symptoms appear when the surface skin temperature reaches a certain height, for example, 93° to 95° F. on the forehead (89.5° to 91.5° in cases of heart disease) and when the relative moisture of the layer of air in contact with the skin increases 20 per cent. to 30 per cent." In all instances where relief was produced by setting the air in motion by the fan, discomfort returned promptly when the fan was stopped. This cycle could apparently be repeated any number of times.

The last step logically in the progress of our knowledge of temperature and ventilation, would seem to be to establish standards.

Any such project is full of difficulties because of the great variations shown naturally by the human animal and because of his marked ability to develop tolerances and to acclimate himself. The same difficulties, however, beset the use of medicines, yet you all agree upon certain dosages of each medicine to be used in advance of knowledge of the variations shown by the particular patient or his tolerances. An interesting and important contribution in this matter, which embodies years of experimenting, is at hand, and I shall speak of it in closing.

The experiments reduce themselves to placing persons in a room, the atmosphere of which may be altered at will, and at suitable times inquiring as to their comfort or discomfort. The room equipment permits of any velocity of movement up to 2800 feet per second, any temperature from 28° to 94°, and any relative humidity from 18 per cent. to 100 per cent. The results of these experiments, combined with earlier experiments in school rooms where the number of subjects was larger but the number of possible variations smaller, have been combined into a graphic chart--Figure I. It is a study of "Degrees of Discomfort" of the average person (in Chicago).

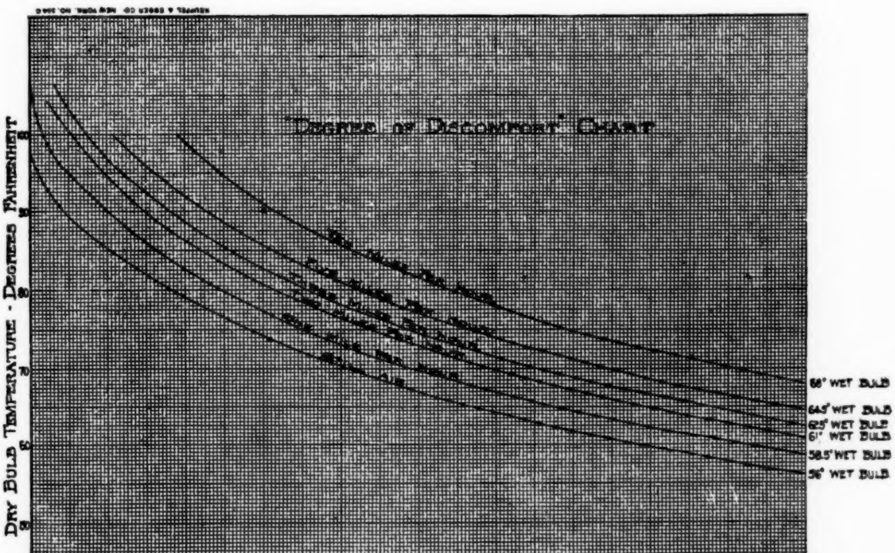

Fig. 1.

Any movement of the air increases the rate of evaporation from the skin, and moves air heated by convection from the skin away from the skin, thus bringing cooler air (at all temperatures below skin temperature) to the skin. The investigation has shown that under certain velocities of air movement, at a given temperature, the average person will be most comfortable when the wet bulb shows an average reading, as follows:

Velocity of Air, in Miles Per Hour	*Wet Bulb Reading*
0	56.0
1	58.5
2	61.0
3	62.5
4	63.5
5	64.5
6	65.5
7	60.0
8	66.5
9	67.0
10	68.0

Since the relative humidity is gotten from the wet bulb reading at any (dry bulb) temperature, it is possible to determine from these figures for any temperature and rate of air motion just what the average humidity for comfort of the average person should be. In the graph, the thermometer (dry bulb) readings are plotted vertically and the relative humidity percentages are plotted hoizontally. Each curve gives the temperatures and relative humidities that combined produce the comfortable wet-bulb reading, at each of the several velocities of air movement stated on the diagram at the end of each curve. The curves for still air and for air at 1, 2, 3, 5 and 10 miles per hour are given.

Thus, to apply these curves to an example: In order to find the approximate temperature for comfort, with 90° F. and 60 per cent. relative humidity, follow the 60 per cent. line up until it intersects the still air line and then read at the left of the table the corresponding temperature for comfort. This proves to be only 65°. Since the actual air temperature was 90°, the degrees of discomfort equal 25°. If, however, a two-mile breeze had been blowing, then 70° would have

been the comfortable temperature, or the degrees of discomfort would have been only 15°. This shows how a gentle breeze may render the hot day more endurable.

It remains to speak briefly of the experimental determinations. The velocity of the wind outdoors is best taken from the weather bureau records. Indoors a sensitive anæmometer, properly calibrated, is used if the air is not still. An easy way to calibrate it is by the aid of the automobile and speedometer, on a calm day.

The relative humidity may be determined quite accurately with the sling psychrometer, and accurately enough, perhaps, for most purposes by the ordinary wet and dry bulb thermometer outfit, *provided* an electric fan is set to drive the air of the room across the bulbs of the thermometers at a rate not less than 15 feet per second,—which is about 10.2 miles per hour.

The experimental results embodied in this graph will enable one to explain his discomfort under any ordinary conditions, if his discomfort be due to the atmospheric conditions. It will also enable him to arrive at a more or less quantitative expression for his discomfort. But it should be added for the benefit of those seeking greater precision throughout a wider range of conditions, that more exact and extensive studies have been made and that the results are available in the literature upon industrial hygiene.

HERALDS OF PROGRESS*

By John C. Krantz, Jr.

PRESIDENT KRUSEN, Dean La Wall, Dean Sturmer, Members of the Board of Trustees, Members of the Faculty, Students and Guests of the Philadelphia College of Pharmacy and Science. I esteem it a signal honor and special privilege to have been asked to address you upon this memorable occasion.

In the year 1798 Napoleon (1), standing in the shadow of the pyramids, addressed his soldiers, saying, "Soldiers forty centuries are looking down upon you." This institution stands today in the shadow of the achievements of its predecessors. Eleven decades are looking down upon you. One hundred and ten years ago Henry Troth (2), Peter Lehman, Peter Williamson and others met in Carpenter's Hall to lay the foundations of this venerable institution. They were men of vision and the soundness of their foresight and judgment is evinced by the service which this institution has rendered to pharmacy during the period of its existence. You have given nobly and unselfishly of the time and talent to American pharmacy of your distinguished sons; a Procter, a Maisch, a Remington, and your most scientifically distinguished alumnus and professor, Frederick Belding Power, have been vanguards of pharmaceutical progress. They have left you a "goodly heritage," but simultaneously a tremendous obligation. The achievements of these men inspire us on one hand and posterity challenges us on the other.

An artist has depicted our children's children (3) sitting in the ashes of this present crumbled civilization, lamenting that they did not have the chance which is ours today. When the kingdom of the Hebrew King Saul was endangered by foreign armies, because he had failed to heed the advice of the prophet Samuel, in his despair he visited the cave of the witch of Endor and cried, "Bring me up the ghost of Samuel." He pled for a ghost of a chance to have returned to him the opportunity which he had lost. Opportunities are not hard to hold, but once having been lost they are many times impossible to regain. Our opportunity is today, it is the present time, it is the age in which we live, our obligations are to make the most of these opportunities. The record which our predecessors have

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handed down is the challenge which posterity makes to give them a ghost of a chance.

Some time ago there was an uprising among a group of European peasants (4); they wanted the establishment of a university. An officer of the government during a riot asked a group of poverty stricken peasants, what do you want with a university. The instantaneous, unanimous reply was, "A university means bread and beer to us." This is synonymous with saying a university is a means of producing the necessities of life for which men will fight.

Your position here this afternoon is more strategic and vital. You have in your hands the tools of happiness, the way to that glorious freedom of good health. Lying upon the beds of thousands of hospitals in this fair land of ours are the sick not in open riot. But with inner rebellion they are looking to this and similar schools of learning to bring them the drug which will turn the tide of battle in their favor and increase that short span between two eternities called life. Your school can mean life and health to men and women. Could there be a greater opportunity for service?

It is unfortunate indeed that our schools of pharmacy are not measuring up to this splendid opportunity for service in as great a measure as it is possible for them to do, once they catch a glimpse of the "spirit on the summit" and become imbued with the "divine intoxicant" (5), the search for truth.

What pharmacy needs today more than anything else is men. Her schools of learning have the physical equipment for scientific research, the coffers of her manufactures are laden with gold obtained by the exploitation of the sick, and fields of service are ready for the harvest, but the reapers are few. Pharmacy needs men. During the Italian campaign Napoleon (6) exclaimed, "Good God, how scarce men are!" There are thirteen million in Italy, and I have with difficulty found two." Again on Russian soil he said, "I have two hundred millions in my coffers and I would give them all for Ney."

The discovery of men for its ranks is the greatest service that can be rendered to pharmacy. Sir Humphrey Davy (7) was an old man and with a record of achievement in science difficult to equal. When he was asked what was his greatest discovery, unhesitatingly he replied, "My greatest discovery was that of my laboratory assistant, Michael Faraday." Pharmacy needs investigators—heralds of progress. That peculiar type of individual who has a zeal for

experimentation and truth. May I pause here to describe them in terms of master investigators?

Clark refers to them as "The Architects of Progress (8), who hew the stones where unseen spires shall stand."

Little (9) calls them members of the "Fifth Estate," names not to be found in Bradstreet or Dun: "Men who have the simplicity to wonder, the ability to question, the power to generalize and the capacity to apply." Another has said, "They are the Lindberghs of science" (10)—they are constantly making excursions out into the unknown fields of endeavor searching for truth, just as did that valiant American sail the uncharted skies to open a new way of trans-oceanic travel.

Wiggam (11) calls them, "The aristocrats of God, those who have given the world the only things worth living for, worth fighting for, and worth dying for." These are the type of men, gentlemen of the faculty, which it behooves you to give to pharmacy. These alone can carry torch, on their shoulders must the ark of science be borne, these alone must push the advance of pharmacy—these are the vanguards on the frontier of knowledge—heralds of progress.

It is true that our profession today is making tremendous commercial strides. Its outpost, the "modern store," follows every pathway of civilization; they are found in the most strategic commercial positions in every American metropolis. No one can deny the dominating commercial position of the modern general drug store. There is a vast chasm between commercial supremacy and scientific achievement; they are not related, nor can they be. The goal of the former is profit, the purpose of the latter is to advance knowledge and make the world a better place to live in.

At the time of the Punic wars (12), there was no maritime power equal to that of Carthage. A great thriving commercial people. The sails of ships of the great merchant fleet dotted the whole Mediterranean until it was said one could not wash his hands in the sea without the consent of Carthage. Teeming with wealth, she produced no philosophers, no statesmen, no poets, no master thinkers, and today the Carthaginian influence in the world has long since been forgotten, while the philosophies, mathematics and science of her contemporary ancient Greece is still making its imprint upon the intellectual world 2500 years later. Pharmacy stands today in the shadow of ancient Carthage—my challenge to you is to train for her the heralds of progress who alone can immortalize your profession.

Today pharmacy needs a revival of the spirit of Paracelsus (13). "Alchemy is neither to make gold nor silver: its use is to make the supreme sciences and to direct them against disease." The value of pure research, research for the truth's sake, research to add to the sum total of truth cannot be overestimated.

In 1883 Dr. A. F. A. King (14) published the results of his observations on "Insects and Disease, Mosquitoes and Malaria" in the Popular Science Monthly. This work served to stimulate the fertile mind of Walter Reed in the direction of the mosquito theory of yellow fever, and he, with James Carroll and Jesse Lazear, were appointed as the yellow fever board and sent to Cuba in 1900. Through the efforts of these heralds of progress Cuba was wrested from the horrors of yellow fever and the mosquito transmission theory made it possible to control the disease. A decade later through methods of Walter Reed the Canal Zone became a livable place for American engineers, which in turn made it possible to sever the "spine of a continent" and merge the waters of the two mighty oceans. Today the commerce of the world passes through the great canal because years ago someone imbued with the search for truth studied the transmission of disease by mosquitoes.

Along a score of different fronts today the mighty armies of science are advancing—you are fortunate to be living in this era of discovery. Consider the advance of organic chemistry. A little more than a century ago Michael Faraday discovered benzene. He was engaged in pure research. A few years later Wöhler broke down the barrier which had so superficially and yet so effectively separated organic and inorganic chemistry. It was he who prepared urea by the evaporation of a solution of ammonium cyanate. He was engaged in pure research.

From these two fundamental experiments a science was born that was destined to change the history of the world. It is estimated that there are over 500,000 (15) separate and distinct organic chemicals of known structure recorded in the literature. Furthermore this number is increased annually by about 10,000 new substances, it is a dynamic science.

Organic chemistry has given the proletarian the luxuries of an oriental monarch, it has been responsible for the synthesis of some of the hormones of our bodies, it has given us potent germicides and our most effective weapons in our combat against disease.

This science had its birth in the fundamental researches of two heralds of progress—our profession can only rise to heights upon the shoulders of these vanguards of knowledge.

Consider the realm of astronomy. In 1564 (16), the same year that Michael Angelo died, Galileo was born. He was imbued with the divine intoxicant, the search for truth. Galileo fitted a leaden organ pipe with two spectacle lenses, both plane on one edge, one convex and one concave on the other. With this crude instrument his hungry eyes peered into the heavens, he beheld the stars—the multitudinous constellations of the milky way and the satellites of Jupiter. Fundamental research, through it the science of astronomy was given an impetus which it never lost.

These same eyes became dimmed in the persecution which the church inflicted upon this great high priest of truth. In 1638 (17) young John Milton stood before the blind scientist—later Milton says, "I found Galileo a prisoner to the Inquisition for thinking in astronomy otherwise than the Franciscan and Dominican licensers thought."

Galileo gave you a great heritage. His science has emancipated you to a great citizenship. We have learned that this great earth of ours and the other members of the solar system are moving through space at a speed of nearly a million miles per day to the star Vega (18). While King Tut was being embalmed, when Caesar was using his dividers on Gaul, while Napoleon was detonating his ambitions in Europe, when Flander's field were being bathed in the blood of the world's battalions, this great universe of ours continued its terrific speed—every heart beat finds us five to seven miles closer to Vega. The spirit of freedom of Galileo permeates modern astronomy —the heralds of progress have broken down the barriers of superstition and permitted man to emerge from a cloistered dweller in cliffs to a fearless citizen of the universe.

Our profession needs this spirit which the "Heralds of Progress" alone can impart.

Turn to the realm of physics. There is a vast chasm existing between the physics of two decades ago and the physics of today. The physical world has had the Curies, whose fundamental researches brought forth radium. Rutherford and Soddy have enunciated the disintegration hypothesis. Thomson, Bohr, Langmuir and Millikan have gone down into the atom and brought to light the basic facts of this universe. Fundamental research has given medicine the radium emanation and X-ray. Moseley has given the chemist a newer

and sounder interpretation of the periodicity of the elements. More recently Millikan's researches (19) in cosmic rays seem to indicate that this universe of ours is not only a disintegrating system, but simultaneously an integrating system, and that the old philosophy of energy dissipation and annihilation is possibly erroneous!

Grove Wilson (20) states, "The atom is man's real work, and some day it may be brought into light and its fierce, strangely guarded secret laid bare. That will bring a real revolution if man is lucky. If not, the release of this stupendous secret may blast humanity out of existence, may blast the world into its elements; and a thousand million years may pass before there is a new world and a new heaven and new curious minded creatures gazing through matted hair at points of light set in the velvet blackness of the night." Fearlessness and courage are among the watchwords of scientific progress, these men stand on the frontier of the eternal, in the zero hour of history, ready to charge forth into an unknown world.

We, in pharmacy, need to imbibe this courageous spirit—its reward is progress.

Let us center our attention upon human biology. Brown-Sequard (21) was doing fundamental research during the latter half of the past century when he studied the classic symptoms which occur in adrenalectomized animals. He was laying the foundation of a new era in medicine. Following the work of this pioneer came the observation of Oliver and Schaefer (22) in 1895, who showed that extracts from the suprarenal glands possessed pressor activity. The crowning culmination of these pure researches brought forth the isolation of adrenaline through the researches of Abel (23) and the synthesis of the compound by Stolz (24) in 1904. One of the most dependable therapeutics agents was thus added to our materia medica. Recently Swingle and Pfiffner (25) have separated the adrenal cortex hormone and laid the way for the control of Addison's Disease.

In 1872 Minkowski and V. Mehring (26) were doing pure research when they showed that by the removal of destruction of that portion of the pancreas known as the islands of Langerhans they could produce the typical symptoms of diabetes mellitus in dogs. They definitely established the organic deficiency responsible for the disease. They laid the basis for the work of Banting and Best (27) in 1922, who, avoiding the pitfalls of the investigators of a third of a century, succeeded in preparing a pancreatic extract of an enzyme-free pancreas which was active in the reduction of blood

and urinary sugar and in its capacity to relieve the cardinal symptoms of diabetes. This classical experiment of Banting and Best gave to the world insulin, a dependable therapeutic agent, which has been responsible for the saving of the lives of a great host of diabetics and has enabled others to regain the energy and strength which transforms a sheer existence into intensive living.

Theophile de Bordeau (21) published his observations in 1776 on the medical analysis of the blood. He was engaged in pure research; he believed that secretions absorbed by the blood determined the sex life of the individual. This was an early precursor of the work of Allen and Doisey (28) of this decade who succeeded in the extraction of the ovarian hormone from the liquor folliculi.

Possibly the crowning experiment in this important field is the work of Zondek and Civeyk (29), in 1930, who have isolated the female sex hormone from the urine of pregnant women and brought forth possibly the first dependable diagnostic test for pregnancy.

Enough has been said to show the far-reaching influence of fundamental research and you have no doubt outrun to my conclusion that the future of pharmacy in its service to humanity lies in the hands of the "Heralds of Progress."

Huxley in his Romanes Lecture on Evolution and Ethics stated, "The ethical progress of society depends, not on imitating the cosmic process, still less on running away from it, but on combating." We cannot allow nature to take her course in the ravages of disease, should we do this in a generation she would grind us to a powder.

In Central America the French left twenty-two thousand tombstones as a monument to their failure to sever the spine of a continent and letting nature take her course in yellow fever and malaria. Had the heralds of progress who have gone before us depended upon her completely, we would go to sea in sailing vessels today, read by the light of a tallow candle, travel across the surface of the earth on the back of a horse, and treat acute appendicitis with a dose of castor oil.

Never before has pharmacy offered such splendid opportunity for pure research, yet the number of the heralds of progress within her ranks is comparatively small.

A dean of one of the best equipped pharmacy schools in this country told me recently that what pharmacy needed more than anything else was a Moses to lead it out of the wilderness. In my opinion we are out of the wilderness; we stand, as it were, on the banks of

Jordan; the promised land lies before you. My challenge to you is—"Enter in."

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MEDICAL AND PHARMACEUTICAL NOTES

MILD MERCUROUS CHLORIDE SUSPENDED IN LIQUID—To the Editor: After examining a patient and making a diagnosis I prescribed:

		Gm. or Cc.
℞	Tincture of belladonna	6
	Calomel (O. K. to fill)	2
	Sodium salicylate	12
	Aromatic fluidglycerate of cascara sagrada sufficient to make	120

M. Sig.: Teaspoonful every three hours in water.

In an hour I received a phone call from the local druggist in reference to the dose of calomel. I advised him that the dose was what I wanted and thought was indicated in this case—in fact, even labeled prescription to that effect in order to relieve him of any responsibility. However, he insisted that one grain was an overdose for every three hours (practically five grains per diem) and would not fill it. So I advised him to return the prescription to the patient that he might have it filled somewhere else. It was filled by another pharmacist without question. The medicine was continued for two days. The patient is entirely well and contented. I would like to know what is wrong with a dose of one grain of calomel when U. S. P. cathartic pills contain one grain and can be bought anywhere and used at random.

M. K., M. D., Chicago.

Answer.—Prescribing such a heavy insoluble substance as mild mercurous chloride in liquid dosage form is undesirable, because of necessary inequality of dosage. Even if the mixture is shaken each time before taking, the mild mercurous chloride will settle so rapidly that the last doses will contain much more of it than the first. Nevertheless, even if the two Gm. contained in the mixture were taken at one time, the patient having refrained from shaking the bottle, no dire result would have followed, unless an intestinal obstruction was present. In such a case, mercurial poisoning might have resulted.

The pharmacist was within his legal right in refusing to fill a prescription that he considered potentially dangerous; for, in spite of the physician's insistence that the dosage was as intended, the pharmacist would have been held legally responsible with the physician in case harm resulted from the medicine. The pharmacist who filled the prescription took a risk, even though a slight one.—*Jour. A. M. A.*, 1931, p. 552.

IMPROVE BREATH TEST FOR DRUNKENNESS—Improvement of a chemical test which will make detection of drunkenness by breath analysis more accurate was reported at the recent meeting of the American Chemical Society by Dr. Rolla N. Harger, of the Indiana University School of Medicine.

Previous attempts to estimate the concentration of alcohol in the body by analyzing the breath have given quite erratic results, Dr. Harger explained. This is probably because the breath analyzed was not always air from the alveoli or air cells in which exchange of oxygen and carbon dioxide between the blood and the lungs takes place.

By the new method, the alcohol and carbon dioxide contents of the breath are determined simultaneously. Since the carbon dioxide content of alveolar air is constant, this gives a means of estimating the alveolar alcohol in any sample of breath.

This method was used on a number of intoxicated subjects and the alcohol figure so obtained agreed well with the concentration of the alcohol in the blood determined directly.—*Science Service.*

CONTROL OF ROACHES—The life history and control of cockroaches is dealt with by F. Laing in "Pamphlet 12, British Museum (Natural History)." Insect powders have been found successful as a means of control, and three formulas are given: (1) Sodium fluoride, three parts, and pyrethrum powder, one part; (2) borax to which pyrethrum powder or a sweetening agent, such as chocolate, has been added; and (3) plaster of Paris, one part, with sugar, two parts. These mixtures should be scattered about the haunts of the cockroaches at night and the dead swept up and burned in the morning. In recent years sprays have been used. To make a suitable spray soak one-half pound of pyrethrum powder in one gallon of kerosene for about two hours and decant the liquid. Methyl salicylate

or an essential oil may be added if a pleasant scent is desired. Carbon tetrachloride may also be used. Where the number of roaches is known to be large, fumigation may be resorted to. Two pounds of sulphur per 1000 cubic feet should be burned, the room being made as airtight as possible with the aid of greaseproof paper, and should remain sealed up for at least an hour. Cylinders containing liquid sulphur dioxide may be employed in place of brimstone. Carbon disulphide at the rate of two pounds per 1000 cubic feet of space is also recommended. The room in this case should remain closed for about thirty-six hours. Under certain conditions fumigation may be carried out by means of hydrocyanic acid gas. This method should be entrusted to someone who is familiar with the process.—*Chem. & Druggist,* March, 1931, p. 364.

CHOLESTERIN HAIR LOTIONS—Such hair washes are best prepared with the aid of anhydrous lanolin, for the reason that this substance contains a large amount of cholesterin. The preparation is carried out in a manner similar to that of lanolin milk, and as much water as possible is added to the mixture without disturbing the emulsion. When the proper care is taken, this offers no great difficulties. Thus ten parts by weight of anhydrous lanolin are mixed with twenty parts by weight of water and then half a part by weight of soap dissolved in twenty parts by weight of distilled water are added. This mixture is thoroughly triturated in a mortar and then from two hundred to two hundred and fifty parts by weight of warm water and 5 c.c. of tincture of benzoin are gradually added.

In another formula fifty parts by weight of anhydrous lanolin are mixed with twenty-five parts by weight of coconut oil, the same proportion of soap powder—eight parts by weight of powdered borax and eighty parts by weight of water, and the mixture is heated. The mixture is triturated in a mortar. Then a mixture of four hundred parts by weight of rose water, the same proportion of orange flower water, 0.2 part by weight of oil of bergamot and the same proportion of tincture of musk are added in small quantities at a time while the mixture is being continuously triturated. Still another formula calls for the solution of one part by weight of cholesterin in ninety-eight parts by weight of 90 per cent. alcohol and the addition of half a part by weight of castor oil as well as the same proportion of heliotropin.—*Med. u. Pharm. Rundschau, through "Drug Markets."*

Sterilization of the Oral Mucosa—H. A. Miller and J. L. T. Appleton ("The Dental Cosmos," January, 1931) have carried out a number of tests on the pre-operative sterilization of the oral mucosa especially preparatory to the injection of local anesthetics, and tabulate the results for antiseptics as follows:

Bacterial condition of oral mucosa treated with various antiseptics for one minute. Growth observed on blood-agar slants after seventy-two hours at 37 degrees C.

Antiseptic	No. tests	Total No. showing growth	Per cent. no growth	Control No. tests	Control Per cent. no growth
Metaphen (1:5000)	7	7	0	7	0
Metaphen (1:2500)	15	15	0	15	0
Metaphen (1:500)	35	19	45.7	35	0
Hexylresorcinol (S. T. 37)	25	20	20.	25	0
Waite's "Topicol"	25	0	100.	5	0
2 per cent. mercurochrome	15	0	100.	3	0
Mercurochrome solvent	15	8	53.3	3	0
Tinct. iodini U. S. P.	25	0	100.	5	0
2 per cent. iodin in ether	15	0	100.	3	0
1.25 per cent. iodine-isopropyl alcohol	15	0	100.	3	0
Isopropyl alcohol, 70 per cent.	30	2	93.3	6	0
Rivinol, 1:100, in dist. water	15	14	6.6	3	0
Acriflavin, 1:100, in dist. water	15	13	13.	3	0
1 per cent. gentian violet, 50 per cent. alcohol	15	0	100.	3	0
1 per cent. brilliant green and crystal violet in 50 per cent. alcohol	15	0	100.	3	0
Alcohol, 50 per cent.	30	15	50.	6	0

0 indicates sterility. Reduction of growth not recorded; only sterility.

The recommendations based on these tests are as follows: Before cutting or puncturing the oral mucosa: (1) Spray the mouth with liquor alkalinus aromaticus. (2) Wipe area on which you desire to work dry with sterile cotton or gauze. (3) Paint area with a solution

made by mixing one part tincture of iodine U. S. P. with 1.5 parts of acetone and 0.5 part of glycerin. (4) Wait for at least one minute by the watch. (5) Do not let lips, cheeks, tongue or saliva come in contact with the painted area from the time you have painted it until you have finished the operation.

Crystals of Digestive Enzyme Isolated—Protein crystals of great digestive power have been isolated from commercial preparations of trypsin, digestive ferment secreted by the pancreas, by Drs. John H. Northrop and M. Kunitz, of the Rockefeller Institute for Medical Research, working at Princeton University.

This discovery is considered to be an important step in the understanding of the chemical mechanism of digestion. Until recently, the digestive ferments or enzymes, of which trypsin, pepsin and rennin are familiar, were matters of mystery to scientist and layman alike. Research such as that of the two Rockefeller Institute scientists is helping to clear up the mystery and is giving the practicing physician new weapons with which to fight disease in the human body.

Dr. Northrop has previously crystallized pepsin, the digestive ferment of the stomach.

Considerable interest, for the scientist at least, attaches to the fact that these two ferments, pepsin and trypsin, are now known to belong to the protein class of substances, to which also belong such foods as meat and nuts.

"The digestive power of the crystals is about ten times that of the most active commercial preparations," the investigators have reported of the trypsin crystals. They digest casein, principal protein of milk, and gelatin, another protein, in neutral solution. They are very unstable and lose some of their activity easily.

Cultivation of American Ergot—Ergot, one of the most important drugs used by physicians, may in future be raised artificially in the laboratories of pharmaceutical factories, instead of being harvested in the natural state as at present. Preliminary experiments pointing to this possibility have been carried out by Miss Adelia McCrea in the botanical laboratories of the University of Michigan.

The quality of ergot was the subject of a Senate committee hearing last June, as a result of charges that the federal food and drugs

administration was allowing importation of impure and adulterated ergot. Miss McCrea's research raises the question of whether the growth of laboratory raised ergot may not be so controlled as to insure a supply of the drug having a high degree of potency. It is too early, however, to consider practical applications of Miss McCrea's work, which is still in the realm of pure science.

Miss McCrea grew cultures of the fungus from which the drug is derived on a variety of media, including mashes and jellies made from various kinds of grain, and simpler jellies containing different sugars. She found malt sugar to be the best food for the fungus. To get ergot to grow in a flask or test tube at all is regarded as a considerable triumph, because under natural conditions it is a parasite, preying only on living plants. She found it to be fairly modest in its food requirements, doing quite as well on a 2 or 3 per cent. concentration of malt sugar as it did on 6 or 8 per cent., and failing to thrive at all at higher concentrations.

It was greedy for oxygen, however, growing much faster when a stream of pure oxygen was passed through its tube than when it was given only air. But on a mixture of half oxygen and half carbon dioxide its growth was considerably retarded. It grew best at temperatures between 68 and 77 degrees Fahrenheit.

Light had a powerful effect on it. Without the shorter-wave visible rays—the blue end of the spectrum—it did not develop the purple color that is its most marked characteristic. Violet light, however, had no stimulating effect, and in repeated doses even retarded development.

Miss McCrea made physiological tests of the ergot growths she raised, and found that they produce most of the effects characteristic of natural ergot, though somewhat less powerfully. The reactions averaged from 40 to 75 per cent. of those obtained with the same concentrations of natural ergot.

In making these tests, however, she had to use the whole vegetative growth of her cultures, for they did not produce the full-grown fruiting bodies which are the only source of commercial ergot at present.

Miss McCrea also made two attempts to infect growing grain with ergot, with the idea that its field cultivation might be undertaken. At present, commercial ergot is obtained solely by hand gathering of wild growths on grain, especially rye and wild grasses. Because of the great amount of hand work involved, and the high cost of

labor in this country, American production of ergot is unprofitable. However, the field experiments did not yield particularly encouraging results, and Miss McCrea concludes that if it ever becomes desirable or necessary to raise ergot in this country the laboratory method is the more promising.

A full technical account of Miss McCrea's work is contained in the current issue of the American Journal of Botany.—*Science Service.*

Lead Poisoning From Toys—Surgeon General Cumming, of the United States Public Health Service, has been informed by leading pediatricians of the occurrence of a number of cases of lead poisoning in infants and children, apparently due to biting lead paint from cribs, toys, etc. The Public Health Service has previously called attention to this possible source of lead poisoning but it is likely that more cases occur than become known. Though lead paint has wide fields of usefulness, the painting of babies toys and cribs is not one of them. It is presumed the manufacturers of these articles will see to it that lead paint is not used for this purpose, but warning is necessary that parents, especially in repainting cribs, should use paints which are free from lead.

Although in recent years it has been found that the human body takes up lead from its surroundings much more frequently than was formerly supposed, and although there are still important industrial sources of lead poisoning which need correction, the incidence of lead poisoning does not seem to be on the increase. One of the most prolific sources yet remaining is the painter's trade, and it is believed that here the dust arising from scraping or sandpapering dry paint may be more important than the actual painting.

Widespread Native Weed Yields Good Insect Poison—Bad news for insects comes from the department of entomology of the Agricultural and Mechanical College of Texas. A weed common all over the country from Texas to Minnesota and from there eastward to the sea has been found to supply a poison very effective against insects. It is a member of the pea family, and its common name is Devil's Shoestring.

V. A. Little, who has been experimenting with preparations of the plant, states in the current issue of *Science* that the best material he obtained was slightly more effective than pyrethrum, a very widely used insecticide, but a little less effective than derris, a poisonous plant from the tropics now coming into use as an insect killer. He does not advise immediate commercial use of the great quantities of it now available in this country, however, because different strains of the plant vary in the quantity of insecticide they will yield.

Tried out on a number of species of caterpillars and adult pest insects, Devil's Shoestring had a devastating effect. It gave results even more promising when used on domestic animals to rid them of insect vermin. Its physiological effects resemble those of derris. It does not have to be swallowed. When it touches an insect it causes paralysis, and after a while the victim dies.

Related plants have been tried out experimentally in Europe, but this particular species has never been given a test to show what it can do against insects.

NEWS ITEMS AND PERSONAL NOTES

Dr. Rosin on Revision Board—Dr. J. Rosin has been elected a member of the Committee of Revision, U. S. P. XI, to take the place made vacant by the death of Edward V. Howell, late dean of the School of Pharmacy, University of North Carolina.

Dr. Rosin was very active in the work of revising the two previous editions of the U. S. P., and is considered an authority on pharmacopœial chemical matters. He has been identified with and largely instrumental in standardizing and improving the quality of reagent chemicals. He is a member of the American Chemical Society's Committee on Reagent Analytical Chemicals. The Chemistry Department of the University of Pennsylvania numbers him among its graduates, and he received the honorary degree of Master of Pharmacy from the Philadelphia College of Pharmacy and Science.

For many years Dr. Rosin was the chief chemist of the Powers-Weightman-Rosengarten Company. He is now vice-president and chemical director of the successors of this company, Merck & Co. Inc., of Rahway, N. J.

The Wellcome Foundation Medical and Chemical Research Building—The Wellcome Foundation Ltd. is about to erect a new medical and chemical research building at the corner of Gordon Street and Euston Road, on the site, 225 feet by 135 feet, now partly occupied by their bureau of scientific research. During many years the foundation has maintained medical and chemical research laboratories, but recent developments have made it necessary to coordinate and extend these activities. The new building will furnish the additional accommodation required, and be provided with the most modern research equipment. Mr. Septimus Warwick, F. R. I. B. A., is the architect.

Di-Hydranol—A New Internal Antiseptic—Sharp & Dohme announce their success in synthesizing on a manufacturing scale a new chemical substance, Di-Hydranol.

This new synthetic chemical possesses over 100 times the bactericidal power of phenol at body temperature. It destroys the putre-

factive flora of the intestinal tract with certainty and regularity. It is non-toxic in therapeutic doses.

Di-Hydranol is absorbed from the intestines only to a small extent; it therefore exerts its full germicidal activity throughout the entire alimentary tract. It destroys the putrefactive bacteria through a highly selective bactericidal action.

In a series of controlled clinical and laboratory tests, it was proved that Di-Hydranol eliminated completely the putrefactive organisms of the intestines in from two days to an extreme of forty-one days.

It is to be supplied in prescription boxes of fifty soluble elastic capsules, each containing 0.15 Gm. in 25 per cent. solution in olive oil.

A New Biological Product—A parasite which attacks and destroys boils, carbuncles and abscesses and heals the diseased parts is a new boon to mankind now offered by medical science.

Widespread interest was created recently in an explanation by Dr. F. d'Herrelle, formerly of the Pasteur Institute of Paris and now of Yale University, of the effective treatment of dysentery by means of what has come to be known as bacteriophage. It has been explained that just as larger animals and plants have parasites that live and grow at the expense of the organism and frequently kill the host on which they live, so also certain bacteria have parasitic diseases which grow at the expense of the bacteria. Those tiny organisms that live on bacteria are called bacteriophage and frequently referred to as merely "phage."

Dr. John F. Anderson, director of the biological and research laboratories of E. R. Squibb & Sons, and for many years in the United States Public Health Service, announces that after more than a year of research and investigation the particular parasitic enemy for boils, carbuncles and abscesses has been found and this modern method of treating them has been perfected. Explaining this new discovery, Dr. Anderson says:

"The 'phage' that has attracted most attention in this country is staphylococcus bacteriophage. Staphylococcus is the organism that is responsible for almost all varieties of boils, carbuncles and abscesses. Staphylococcus bacteriophage is a parasite of the staphylococcus which grows in or on the bacteria and finally destroys it.

"If a drop of the 'phage' is added to the culture of staphylococcus, the bacteria are killed and dissolved and the culture becomes sterile.

If a drop of this dissolved culture is added to the fresh staphylococcus culture the same thing takes place. This process can be carried on indefinitely. In other words the bacteriophage reproduces itself in causing the destruction of the bacteria on which it grows. The dissolved culture contains bacteriophage in a concentration so great that one-billionth of a cubic centimeter will cause destruction of a culture.

"The Squibb laboratories after more than a year of research and investigation have made this new staphylococcus bacteriophage available to the medical profession."

BOOK REVIEW

Quantitative Pharmaceutical Chemistry, by Glenn L. Jenkins, Ph. D., Professor of Pharmaceutical Chemistry, and Andrew G. DuMez, Ph. D., Professor of Pharmacy and Dean of the School of Pharmacy, University of Maryland. First edition, 1931, 408 pages. McGraw Hill Book Company, Inc. $3.50.

In presenting this book on the theory and practice of quantitative analysis as applied to pharmacy, the authors have divided their treatment of the subject into four parts. Part I deals with general gravimetric, volumetric, gasometric and electrolytic determinations. Part II describes the methods for the determination of physical constants, *i. e.*, specific gravity, melting and boiling points, refractive index, rotary power, viscosity, etc. Part III considers the special methods used in the analysis of oils, fats, waxes and the evaluation of alkaloid and enzyme containing drugs, etc., while Part IV describes some non-official methods such as the colorimetric and electrometric determinations of hydrogen ion concentration and potentiometric, photometric and ultimate methods of analysis.

The procedures are explained in accordance with modern theory and questions and problems are given at the conclusion of the description of each exercise. In general, the subject matter is presented in a form which should make the book valuable for instructive purposes and also as a handbook for pharmaceutical chemists. The authors are to be commended on their choice selection of a variety of type procedures which heretofore necessitated the use of many reference books. The book is relatively free of the usual first edition errors.

A. O.